

Introduction to Zoology (Volume 2); For the Use of Schools

**Robert
Patterson**

INTRODUCTION TO ZOOLOGY : FOR THE USE OF SCHOOLS (VOLUME 2)

Robert Ballerstein



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Robert Patterson



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INTRODUCTION TO ZOOLOGY : FOR THE USE OF SCHOOLS (VOLUME 2)

PREFACE TO THE FIRST EDITION.

PRIOR to the publication of the first part of this little book, I had a few copies struck off in a cheap form, without the illustrations, and submitted to the revision of Naturalists, whom I have the happiness to number among my friends, and who had made certain departments of Natural History their especial objects of study. This was done in order that the book might be correct in regard to the facts, and that the young reader might have as little as possible to unlearn. It was also laid before some other friends, who took a deep interest in educational works, could estimate the difficulties with which the language of science is fraught, and point out any lurking ambiguity which had escaped my own attention.

Sensible of the improvement effected on Part I. by its having passed through this ordeal of friendly criticism, I hesitated not to pursue the same course with the present part, and thus to render it, as far as in my power, worthy of the kind reception that had been awarded to the first. I have endeavoured throughout, to mention in the foot notes, the sources whence the information has been obtained; not only that an authority might thus be given for the facts, but that the learner who felt disposed to enter more fully into the subject might be directed to trustworthy guides.

The illustrations are, for the most part, those of M. Milne Edwards' "Eléments de Zoologie," and "Cours Élémentaire." A few additional figures are introduced, which are copied from standard works on British Natural History, and acknowledged as they occur. A copious Index and Glossary have been added, and complete the work.

I have done my best to make the book useful and attractive to the young. If that object has been attained, I should hope that readers of more mature years will cast a lenient eye on its defects.

R. PATTERSON, Belfast, 3, College Square North,

February 22, 1818.

PREFACE TO THE SECOND EDITION.

WHILE revising for the press, the edition now presented to the public, I gladly availed myself of the opportunity of correcting a few trivial errors, both of the press and the pen. More than this I have scarcely ventured to do, as teachers of great experience have informed me, that much inconvenience is occasionally felt in the school-room, from differences between successive editions of the same book. Guided by their advice, I shall endeavour in future editions, if such should be called for, to keep pace with the progress of science, by means of an appendix, or of foot notes, rather than by changes in the text. I have only further to add, that a few wood-cuts of a superior kind, have been introduced instead of some of the illustrations which formerly appeared.

Belfast, 3, College Square North, 3rd September, 1849.

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PART II.	
"Earth in her rich attire,	
Consummate lovely, smiled; air, water, earth,	
By fowl, fish, beast, was flown, was swum, was walk'd."	

MILTON'S PARADISE LOST.

WE have had our attention directed to the three groups of animals termed "Invertebrate," from the absence of the vertebral column; and we are now prepared to enter upon the examination of the more highly organised beings which constitute the fourth great division of the animal kingdom. These have a more complex structure and a higher intelligence; many of them by their great strength and vast proportions must excite our amazement; and in this class, after passing many inferior grades, we reach to man himself, "the paragon of animals."

The most obvious character by which the Vertebrate Animals are distinguished from the lower tribes is, as the name denotes, the possession of a skull and back-bone; or rather by their ' having the brain and principal trunk of the nervous system included in a bony articulated case, composing the skull and vertebral column, "t There are other important

"Vertebral, as consisting of segments of the skeleton, which turn one upon the other, and as being the centre on which the whole body can bend and rotate; from the Latin *verto*, *vertere*, to turn." Professor Owen's Lectures on the Vertebrate Animals.

f Manual of British Vertebrate Animals. By the Rev. Leonard Jenyns, M. A, though less striking characteristics. Vertebrate Animals possess red blood, a muscular heart, distinct senses, a mouth furnished with two jaws moving vertically, and limbs which, however modified in form, never. exceed four in number.

The skeleton of Vertebrate Animals presents considerable variety, not only in its form, but in the material of which it is composed. Bone consists of animal matter, chiefly gelatinous, hardened by a general diffusion of earthy particles. The proportion of the animal and of the earthy parts, or, in other words, the proportion of the organic and inorganic matter, varies in different classes. " Fishes have the least, birds the largest proportion of earthy matter; 77 " the mammalia, especially the active predatory species, have more earth, or harder bones, than reptiles." In each class there are differences in the density of bone among its several members. For example, in the freshwater fishes the bones are lighter, and retain more animal matter, than in those which swim in the denser sea; and in the dolphin, a warmblooded marine animal, they differ little in this respect from those of the sea-fish.

The Vertebrate Animals are distributed into four classes, namely: I. FISHES, II. KEPTILES (Tortoises, Lizards, Serpents, and Frogs), III. BIRDS.

IV. MAMMALIA. (Man, Bats, Whales, and Quadrupeds),

Two of these, Fishes and Reptiles, are, with few exceptions, cold-blooded; and the remaining two, Birds and Mammalia, are warm-blooded.

Professor Owen's Lectures on the Vertebrate Animals, p. 25.

u They that go down to the sea in ships, and occupy their business in great waters; " These men see the works of the Lord, and his wonders in the deep."

PSALMS.

How widely different are the ideas suggested by the word " Fish" to the minds of the angler, the epicure, the fisherman, and the naturalist! The last is here to be our guide; and, according to his definition, fishes are cold-blooded animals, eminently and specially adapted for living as inhabitants of the water. The body is, in most instances,

covered with scales; they have fins instead of feet; and respiration is carried on by gills. The young are produced from eggs.

DISTRIBUTION. Fishes are found in rivers, lakes, and seas, and, according to the laws of geographical distribution, have certain limits within which they range, and beyond which they seldom pass. Some live habitually in temperatures far above that which we would have ventured to suppose. Thus, fishes have been observed in a hot spring at Manilla, which raises the thermometer to 187, and in another in Barbary, whose usual temperature is 172; and Humboldt mentions that, during his researches in tropical America, he found them thrown up alive from the bottom of an exploding volcano, along with water at that time so hot as to raise the thermometer to 210, or within two degrees of the boiling point. An observation, made under such circumstances, does not, however, furnish any evidence as to the temperature of the water in which such fishes habitually lived. When the vital actions are suspended by excess of cold, and the fish congealed in a mass of ice, life does not appear to be permanently extinguished. With the gradual thawing of the ice, all the powers of life return: hence, in the northern parts of Europe, Perch and Eels are conveniently transported from one place to another while in a frozen state. Even the same species seems

See Notes to Dr. W. F. Edward's work "On the Influence of Physical Agents on Life."

capable of bearing considerable extremes of heat and cold. The delicate-looking Gold-fish thrives and breeds to excess in water the temperature of which is so high as 80, and has been known to be frozen into a solid body of ice, and revived by the gradual application of warmth.

FORM. The great variety of form observable among fishes may be illustrated by reference to some of our most common native species the Eel, the Plaice, and the Haddock. Some fishes have aspects so strange and grotesque that the names-Fiddle-fish," "Red-riband," and "Hammer-head," have been bestowed on them, as indicating their resemblance to some well-known object. There are some which, to a certain extent, can vary the form of their body at pleasure. Thus the Diodon, or Globe-fish (Fig. 179), by swallowing air,

Fig. 179. GLOBE-FISH.

can inflate itself like a balloon. The air passes into the first stomach, which occupies the lower surface of the body. This part, becoming the lightest, is that which remains uppermost, and the fish floats on the surface with its usual position reversed. But, while thus floating without effort, it is in the most perfect security from all its usual enemies; for, owing to the distension of the skin, the numerous spines with which it is beset become erect, and present a bristling front on every

Jesse's Second Series of Gleanings in Natural History.

f This fish belongs to a family which has no true teeth, but in which the gums are covered with a substance resembling ivory. The enamel in each jaw is without any division, so that the fish appears to have but two teeth whence its name Diodon.

side to all assailants. Cuvier doubts whether the Diodon, when in this position, is able to swim; but Mr. Darwin's observations show that it can not only move forward in a straight line, but that it can also turn to either side. f

COVERING. Most fishes are covered with scales, which differ considerably in their shape, and are yet so uniform in each particular kind that they serve as valuable aids in the discrimination of species. Those along the well-marked line observable on both sides of the body are distinguished from the others in shape, and each of them is found to be pierced with a small hole, which is, in fact, the extremity of a tube. Through these orifices a mucus or slime is emitted. This forms a coating to the body, and diminishes the friction of its passage through the water. These apertures are, in general, larger and more numerous about the head than over the other parts, and may be regarded as one of those beautiful provisions of Nature which we are permitted so frequently to observe and to admire, "Whether the fish inhabits the stream or the lake, the current of the water in the one instance, or progression through it on the other, carries this defensive secretion backwards, and spreads it over the whole surface of the body." J The scales are sometimes marked with minute lines, possess a varying metallic lustre, and exhibit a diversity of brilliant colours, which render them highly attractive objects. The poet is perfectly accurate when he describes fishes, which,

"Sporting with quick glance,

Show to the sun their waved coats dropt with gold." MILTON.

Thus the wide-spreading sea has in its waters tribes of beings fitted for that element, and scarcely, if at all, inferior in richness of colouring, variety of figure, or grace of movement, to those which are the admired denizens of the air.

M. Edwards' "Siemens," p. 305. Koget's Bridgewater Treatise, p. 433.

f Darwin's Journal, p. 13. "Voyages of the Adventure and Beagle."

j Yarrell's History of British Fishes, p. 4.

The brilliant metallic colours of the scales of fishes are thus accounted for by Dr. J. L. Drummond: "The scales of fishes are pellucid; and their brilliant appearance is owing to a thin film which covers the under side of each scale, and is entirely formed of spicula, as is easily proved by scraping off a quantity of scales, and agitating them in water with a stick or other body, so as to detach the films. The water will then be found to contain thousands of moving spicula, which in the sunshine may be dis-

But although we may convince ourselves of the truth of this remark, by an examination of those on our own shores, we should not limit our view to them, but extend it to those of other seas. There, with new forms we find new vestments. Thus, the Trunk-fish (Ostracion, Fig. 180), and the Pipefishes of our own shores (Fig. 182), instead of being covered with flexible scales, are clad in a covering of bony plates firmly united together, re-Fig. 180. **TRUNK-FISH.** minding us of a tessellated pavement; and if we look back to those which in remote eras were the inhabitants of these seas, and whose remains are found embedded in rocks of marine formation in different parts of these islands, we find numerous tribes whose coats of mail did not consist of bone but of enamel.

SENSES. The sense of feeling can scarcely be exerted in its fullest extent by the bodies of fishes, covered as they are with their scaly integuments. From this remark, however, we should except the long cirri or feelers of certain fishes, which are placed about the mouth. "These appendages," says Mr. Yarrell, "are to them delicate organs of touch, by which all the species provided with them are enabled to ascertain, to a certain extent, the qualities of the various substances with which they are brought

in contact; and are analogous in function to the beak, with its distribution of nerves, among certain wading and swimming birds which probe for food beyond their sight; and may be considered another instance, among the many beautiful provisions of Nature, by which, in the case of fishes feeding at great depths, where light is deficient, compensation is made for consequent imperfect vision."! As the cerned with the utmost ease by the naked eye. The scales of the Salmon answer best for the purpose, as they are large and easily detached." " On Certain Appearances Observed in the Dissection of the Eyes of Fishes." Trans. Roy. Soc. of Edinburgh. 1815.

The slender, flat, silvery bodies, here named " spicula," are perfectly opaque, and must therefore be examined under the microscope by reflected, not by transmitted light: when thus seen their brilliancy is almost too great for the eye to sustain. Idem.

M. Edwards's " Siemens," p. 303. Roget, p. 432, t British Fishes, p. 30.

prey of fishes is seized by the mouth, and retained there until swallowed; and as the mouth at the same time admits the stream of water to the gills, hut little mastication can possihly take place; there is, consequently, hut little exercise of the sense of taste. Its existence is, however, indicated in some species both by the structure of the skin which covers the palate, and by the supply of nerves.

The sense of smell would appear to be enjoyed in great perfection, not only from the development of the olfactory nerves, but also from observations respecting habits. Mr. Jesse states of fish which he kept in a pond suitable for the purpose, that they preferred paste arid worms that had been prepared by particular perfumes.

The existence of the sense of hearing in fishes has been questioned ere now, because there is no external organ analogous to an ear. But the pleasing writer just quoted informs us, that he has seen fishes suddenly move at the report of a gun, though it was impossible for them to see the flash; and we know that the Chinese summon their Gold-fish to their food by the sound of a whistle. The researches of the anatomist would, however, be sufficient of themselves to remove such a doubt, if it were ever seriously entertained. He reveals to us the existence of a special apparatus for the purpose, presenting great diversity in its arrangement; and we learn that in cases such as those just mentioned, the sonorous vibrations of the water were communicated to the organ of hearing through the medium of the solid parts of the body. In many species there is a communication between the ear and the air-bladder; and it has hence been inferred that the air-bladder, among other uses, serves to increase the intensity of the undulations communicated through water to the body of the fish. f With the parts of the auditory apparatus, called the otolites, or ear-bones, every one is familiar.

The sense of sight exists in great perfection; but the lenses of the eye are modified to suit the denser medium through which the rays of light must pass. In general, the eye is much rounded, and the pupil is large, so as to allow the greatest possible quantity of light to enter. But while such careful arrangements are made for the sense of vision, in all cases where that power can be exerted, the economy of nature,

Gleanings in Natural History, p. 74.

t Miiller, quoted in Owen's Lectures, p. 211.

which gives nothing in vain, has withheld the gift from those species whose dwelling-place is such as to preclude the possibility of its exercise. An instance of this is supplied to us from Kentucky, where there is a cavern, known because of

its great dimensions by the name of the Mammoth Cave. It is said to extend to a distance of upwards of twenty miles, and has obviously been excavated by the long continued action of a subterranean river. There is an expanse of this river, about four miles from the entrance, forming a subterranean lake. Here the sense of sight would be useless; and it is found, accordingly, that the fishes which inhabit those gloomy waters are without eyes; or, to speak more correctly, the visual organs exist only in a rudimentary condition. The capture of these fishes is, nevertheless, difficult, because of the great acuteness of their sense of hearing.

The eyes of fishes exhibit striking peculiarities. They are without eyelids, properly so called; and as the eye is at all times washed by the surrounding water, that gland which supplies moisture to the eye of the higher vertebrate animals is not required, and therefore does not exist. The colours of the eye are of great beauty, varying through various shades of black, blue, red, yellow, and richest orange.

LOCOMOTION. We now turn to the consideration of the various structural peculiarities, by means of which fishes are enabled to move through the waters with the same, or even greater ease, than the Hawk and the Swallow wing their course through the air. The first bears reference to the weight of the body of the fish, compared with that of the medium in which it lives. The specific gravity, to use the proper term, is nearly the same in both; or, in other words, the weight of the body of the fish is nearly the same as that of an equal

There is a popular description of the Mammoth Cave in Chambers's *Edinburgh Journal*, 1837, vol. vi. and again, in 1843, vol. xii.

f W. Thompson's *Notice of the Blind Fish, Cray-fish, and insects from the Mammoth Cave, Kentucky.* *Annals of Natural History*, vol. xiii. p. 112. Some of these blind fish are preserved in the Belfast Museum. Not only the fish, but the Crustacea and insects, are specifically distinct from those found elsewhere; and in all of them the eyes are apparently wanting, or greatly diminished in size. The "Blind-fish" (*Amblyopsis spelceus*) is described in Silliman's *American Journal of Science*, July, 1843, p. 94; and in *Annals Nat. Hist.* Oct. 1843.

The fold of the skin observed on the eyes of the Dog-fish and other Sharks, is not generally regarded as a true eyelid.

bulk of water. If the specific gravity should be increased, the fish would necessarily descend, without any muscular exertion; or, if diminished, the fish would become lighter than the water, and would, therefore, rise to the surface. A beautiful arrangement, by which the fish can thus rise or sink at pleasure, and without exertion, is exhibited by a singular and effectual piece of mechanism, provided apparently for this purpose. It is a membraneous bag, placed at the lower side of the spinal column, and known as the "swim-bladder" or "air-bladder." In the Cod-fish it is the part which is called the ' ' sound. " It differs much in form, and sometimes consists of two or more membraneous bags, with small connecting apertures, or with the divisions quite distinct, or with prolongations from the sides or ends. But whatever be the form, the principal use seems to be the same namely, that of enabling the fish to regulate the specific gravity of its body.

Professor Owen regards it as the representative in fishes of the true lung of the air-breathing vertebrate animals. It is brought, as we have seen (p. 217), into connexion

with the chamber or labyrinth of the organ of hearing; and in a few fishes, such as the Gurnard, it is subservient to the production of sounds, which are caused by the air passing from the air-bladder, by means of an air-duct, into the gullet (oesophagus). It appears also to act, in some cases, as a safety-valve against high-pressure, when the fish sinks to great depths, and to a limited extent as a protection against the too sudden expansion of the gas, when the fish rises to the surface.!

When we begin to examine to what extent this mechanism prevails among fishes, we find it is by no means universal. It is not observed in the Plaice, the Turbot, the Sole, and other flat-fishes; and as these different species live near the bottom of the water, we are at first inclined to say it is not given to them for that reason, but that it is given to those which are in the habit of rising and sinking. A little further examination, however, shows that we are mistaken. Eels, which live near the ground, have the swimming bladder well developed; while the Red Mullet, which has no swimming

Lectures, p. 227.

f The gas in the air-bladder is found to consist of nitrogen and oxygen, the constituents of atmospheric air, in varying proportions. No hydrogen has ever been detected Owen's Lectures, p. 277.

bladder, seems, in its habits, to be similar to fishes which are thus provided. Nay, of the two species of Mackerel found on the British coasts, both of which swim near the surface, and with apparently the same ease and swiftness, the one has a swim-bladder and the other has not.

The external organs of motion act in a manner more easily understood. They consist of the tail and fins. We use the word "tail" as expressing not only the lower extremity of the body, but also the fin by which the body is terminated, appropriately called the "caudal fin" (Latin, cauda, a tail). This is the most efficient organ in progression. It acts upon the water somewhat like the oar of the boatman, when he propels his little craft by that alternate movement of the oar which is called "sculling." The tail placed vertically in fishes, but horizontally in whales is a very powerful instrument of motion. To its movement a great part of the muscular power of the fish can be applied; and the great flexibility of the skeleton largely adds to the effect. The fins on the upper and lower sides of the body bear their part in the exertion, or unite with those nearer the head in retarding, stopping, or changing the direction of the movement. The annexed figure of the Perch (Fig. 181) exhibits the fins, and also the spiny processes by which they are supported.

Fig. 181. SKELETON OF THE PERCH.

The fins upon the back of the fish are naturally termed the "dorsal" fins (dorsum, the back), and if there be more than

Yarrell's British Fishes, vol. i. p. 39.

one, that nearest the head is distinguished as "the first dorsal." Those near the gills, on what might be called the shoulders of the fish, are the "pectoral," and the pair nearest to them, but on the lower surface of the body, are of course the "ventral."! Thus the fins, in all cases, are named from the part of the body to which they are attached. We had last summer, 1846, an opportunity of observing the capability of the fins and tail, in enabling a fish to achieve a movement of a very unusual kind. We had taken in a towing-net one of the Pipe-fishes (*Syngnathus acus* Fig. 182), which

had been swimming near the surface, and had placed it in a basin of sea-water. One of the long-

Fig. 182. PIPE-FISH.

bodied Crustacea, which are abundant during fine weather, and had been captured at the same time, was placed in the same vessel. It was a species of Gammarus, and about an inch in length. The Gammarus would seem to have got tired of

Latin, pectoralis, of or belonging to the chest.

t Venter, ventris, the belly. The fin or fins between the tail and the vent are called the "anal."

J Among the pleasant circumstances connected with the preparation of this little book, I reckon the kindness with which my efforts have been encouraged and assisted. Among those to whom my obligations are thus due, I must make especial mention of Mr. Yarrell and Mr. Van Voorst, by whose liberality I have been permitted to copy some of the beautiful illustrations of the ' British Fishes. 1 ' They are the figures numbered 182, 183, 191, 194 195, 204 K. P.

Its appearance will be best understood by the annexed figure of Gammarus locusta.

VOL. II. B swimming, and, for a resting-place, it fixed itself on the back of the Pipe-fish, close to the tail. The fish had not been a consenting party to this arrangement, and soon evinced its dissatisfaction, by lashing the tail with great violence on each side, to dislodge the intruder. He, however, kept his hold; and so soon as the fish ceased for a few seconds, he crept a little further up on the back, as if aware that the velocity of movement was less near the centre of the circle. The fish lashed the water again with great violence, but without any good result; and so soon as it stopped, the Gammarus crept up a little nearer to the head. The Gammarus seemed to be the marine prototype of the old Man of the Mountain, whose pertinacity in retaining his place on the back of Sinbad the Sailor is a portion of that lore of our boyhood that is never afterwards forgotten. The Pipe-fish then changed its tactics. Instead of lashing with its tail, it gave to its whole body the kind of movement it might have had if fixed on a Lilliputian spit, and in the act of being roasted. The body was made to revolve round and round on its longitudinal axis; but the Gammarus still held on, and, at each interval of rest, made a few steps further in advance. This was more than once repeated, until, pitying the poor Pipe-fish, we removed the cause of its annoyance to another vessel.

In the Flying-fish (Fig. 183, *Exocoetus volitans*), more

Fig. 183. FLYING-FISH.

than one species of which have been taken off the British coasts, the pectoral fins are extremely large, and remind us of wings. But in reality the fins never act as wings; nor can these fish, with correctness, be said to fly. They have the power of springing out of the water with such force, that

Capt. Hall has seen them pass over a space of 200 yards, but they cannot alter the direction of their course, and the expanded fins, when in the air, serve only to make the descent more gradual.

RESPIRATION. The heart of fishes is composed of two cavities only. It receives the blood which has circulated through the system, and propels it to the gills. These are the great organs for respiration, and in the greater number of fishes are arranged in the form of arches on each side of the hinder part of the head. The water is taken in at

the mouth, and passes out between these arches, where the venous blood in the gills is purified by the air diffused through the water. The delicate membrane by which the minute ramifications of the blood-vessels are supported, forms no obstacle to the free action of the water on the impure or carbonated blood. The details connected with the circulation will be more easily understood by an examination of the annexed figure (184) than by any formal description. The true cause of death in a fish kept out of water is an interesting question, which appears to have been satisfactorily answered by M. Fleurens, a French physiologist. Though the gill-cover be raised and shut alternately, the gills themselves are not separated. Their fine filaments rapidly dry and cohere together. The blood can no longer circulate through them, and hence it is not affected by the vivifying influence of the oxygen of the air. "The situation of the fish is similar to that of an air-breathing animal enclosed in a vacuum, and death by suffocation is the consequence."! The gills vary considerably in form and arrangement. Some are convoluted, some are in little tufts, some are enclosed in cavities, with circular orifices, and others furnished with gill-covers composed of distinct bones, to which certain fixed names are appropriated.

POOD. Some fishes live upon marine vegetables. The species of one genus (*Scarus*) are known to browse upon the living polypes which build up the coral reefs; and as the polypes retreat, when touched, into the star-shaped cavities of their support, these fishes are furnished with a dental apparatus

Fragments of Voyages and Travels. Second series, vol. i. p. 220. A more recent writer asserts that the fins are used as wings; vide Note in Edinburgh Phil. New Journal, April, 1847, p. 384, from Gardner's Travels in Brazil.

f Yarrell, vol. i. p. 67. Owen, p. 60.

sufficiently powerful to reduce it to a pulp. To some the dead animal body seems to be not less acceptable than the

Branchial Artery

Arterial Bulbx.

Ventricle—.

Auricle

Venous Sinus-

Vena Porta Intestine-

Vena Caval- ro

X Vessels of the Gills

Dorsal Artery

"" Kidneys I Dorsal Artery

Fig. 184. CIRCULATING APPARATUS OF FISH.

living. Star-fishes, Crustacea, and such mollusca as are not too bulky or too well defended, constitute a large portion of the food of many fishes; and to this must be added the young and weaker animals of their own class, One of our justly popular poets has said:-

"Even tiger fell, and sullen bear, Their likeness and their lineage spare; Man only mars kind Nature's plan, And turns the fierce pursuit on man."

ROKEBY, canto iii. stanza 1.

Such a remark is altogether inapplicable to the voracious tribes of which we at present treat, and we would refer to it here only to show how much more completely "kind Nature's plan" is carried out by the present arrangement. As it is, "the multitudinous seas" are peopled with their finny tribes; and we cannot doubt that the exercise of their various powers in the pursuit of prey, the escape from danger, and all else that is essential to their well-being, is fraught with happiness. They have no apprehension of death; and when it does come by the jaws of a more powerful assailant, the pain is brief and transient. The pleasure has extended throughout the duration of life; the final pang endures but for a moment. Great, therefore, in the aggregate, is the amount of happiness secured under these wise and bountiful dispensations of Providence. Did fishes not constitute the food of fishes, how few comparatively could exist! The naturalist consequently beholds, in all the havoc and destruction of life by carnivorous animals, a merciful dispensation, and is prepared to give his assent to the reflections of the poet:

"Harsh seems the ordinance, that life by life Should be sustained; and yet when all must die, And be like water spilt upon the ground, Which none can gather up, the speediest fate, Though violent and terrible, is best.

"'Twas wisdom, mercy, goodness, that ordained Life in such infinite profusion. Death So sure, so prompt, so multiform."

MONTGOMERY'S "PELICAN ISLAND."

To those who have never considered the omnivorous appetite of fishes, the examination of the stomach of a few of those which are most commonly used as food, will furnish very sufficient evidence of their habits. Perhaps the fact cannot be better exemplified than by quoting a passage from a lecture delivered by Dr. Houston of Dublin, before the Royal Zoological Society of that city:

"This preparation (for the fidelity of which I can vouch, as it belongs to the Museum of the Royal College of Surgeons, and which may be taken as a fair average specimen of a fish's breakfast party, captured at an early hour of the morning) will serve as an illustration of the voraciousness of their habits. Here is the skeleton of a Frog-fish, two-and-a-half feet in length, in the stomach of which is the skeleton of a Cod-fish, two feet long; in whose stomach again are contained the skeletons of two Whittings of the ordinary size; in the stomach of each Whiting there lay numerous half-digested little fishes, which were too small and broken down to admit of preservation. The Frog-fish, with all these contents, was taken last summer by the fishermen, and offered for sale in the market, as an article of food, without any reference at all to the size of its stomach, which to them is an every-day appearance."

TEETH. From considering the food of fishes, we naturally turn to the means by which that food is taken. Here we perceive at once that we have got into a new country, and that the tribes by which it is peopled secure their prey by modes very different from those which we have hitherto witnessed. In some of the lower tribes, the action of parts adjoining to the mouth caused currents in the water, and thus supplied the animal with food. The suckers of the Star-fish and the Sea-urchin held fast the prey on which the creatures fed. The lower jaws of the carnivorous beetles maintained their hold while the upper jaws performed their office of laceration. The larger Crustacea had feet which did the same duty. The Cuttle-fish, by means of its suckers, rendered

escape impossible, and held its struggling captive firm as in a vice, while its parrot-like beak tore it to pieces. But fishes are destitute of all these appliances. The teeth must seize the prey, and must retain the struggling and slippery victim until swallowed; and admirably are they fitted for the performance of their appointed functions; so much so, indeed, that the anatomist finds difficulty in obtaining the command of language sufficiently varied to portray the singular diversity and beauty which they exhibit. "The teeth of fishes, in fact, in whatever relation they are considered whether in regard Saunclers's News-Letter.

to number, form, substance, structure, situation, or mode of attachment offer more various and striking modifications than do those of any other class of animals."

The teeth of some fishes, as the true Red Mullet, are so fine and close set, that they may be felt rather than seen, and have been compared to plush or velvet. Others, a little coarser, resemble the hairs of a fine brush; when stronger, they are like stiff bristles; and some are bent like hooks and barbed. Some of those in the Pike are shaped like the canine teeth of carnivorous quadrupeds; and some molar teeth are elliptical, oblong, square, or triangular. To such teeth, those of the Sharks (Fig. 185, 186) shaped obviously for piercing, cutting, and holding, offer an interesting contrast.

Fig. 185. Fig. 186.

TEETH OF SHARK (Notidanus.) TEETH OF SHARK (Odontaspis).

Nor is the variety in point of numbers less than that of form. The Lancelot, the Sturgeon, and the Pipe-fish are without teeth. The Wolf-fish, on the contrary, has a mouth so paved with teeth that it breaks shells to pieces, and lives on the contained animals, separating the one from the other so effectually, that the food, without further preparation, is ready to be consigned to the stomach. "In all fishes the teeth are shed and renewed, not once only, as in mammalia, but frequently, during the whole course of their lives."!

At the back part of the mouth, the upper end of the gullet (oesophagus) is expanded and forms a cavity known as the pharynx. In many species of fish this is furnished with teeth, and it becomes an interesting question what can be their use in such a situation? A recently swallowed fish, taken from the stomach of a Pike, may show marks of the

Owen's Odontology, page 1. It is from this splendid work and the more recent Lectures of the same eminent author, that our information respecting the teeth is derived.

f Yarrell.

large canine teeth, but has obviously not undergone any further subdivision. It has now been ascertained that the coarser portions of the food, from time to time, return into the oesophagus, and are brought within the sphere of the teeth with which the pharynx is furnished; and, after being there carded and comminuted, are again swallowed. In the Carp, the Tench, the Eel, the Pike, and many other fishes, we have thus an action analogous to that of rumination in the cattle of our pastures.

REPRODUCTION. A few fishes are produced alive as, for example, the young of the Viviparous Blenny; but such instances are rare; and, as a general rule, it may be stated that fishes are produced from eggs deposited by the female and fertilized by the male. The lobes containing the ova are those to which we are accustomed

to give the name of " pea " or " roe," and the corresponding but softer lobes in the male fish, are those which are equally well known as the " milt." It has been found by experiment, that when the spawn of both sexes has been taken from dead fishes, and mixed together, the ova, placed under water and kept in a proper situation, will produce young. This fact may serve, as Mr. Yarrell remarks, to explain how it is that ponds in the East Indies, which have become perfectly dry and the mud hard, have been found after the rainy season with fishes in them, although there did not exist any apparent means by which fish could be admitted. The impregnated ova of the fish of one rainy season continue unhatched in the mud while the pond is dried up; but then vitality remains unimpaired, and the young are produced under the influence of circumstances favourable to their development when the rainy season has again arrived. We can thus explain, by the operation of natural causes, what was regarded as a puzzling phenomenon, for the solution of which many hypotheses have been framed, alike destitute of any solid foundation.

DISTRIBUTION. The researches of naturalists have shown that certain fishes are not merely limited in their range, according to the laws of geographical distribution, but also have certain depths to which they are in a great degree restricted. Hence, some are most usually found at or near the surface; some are ground-feeders, and are taken at consider-

Owen.

able depths; and some occupy various intermediate stations. When we reflect on the great amount of animal life which the ocean in its several zones of depth must thus support, and consider that by far the greater number of young fishes never attain maturity, but form the appointed food of their more powerful neighbours, it is obvious that the young fry must be produced in numbers sufficient to bear this ceaseless destruction, and yet to have among them a sufficient number of individuals which escape these perils to attain a certain degree of maturity, and, by the deposition of their ova, prevent the species from perishing. And accordingly we find here, as in every other department of nature, that HE who framed the mighty scale of created beings has so arranged the living mechanism, that the continual production is equal to the continual waste. The number of ova which some of our native fishes produce is so very astonishing that it would be regarded with doubt, except on the most unimpeachable testimony. So many as 280,000 have been taken from a Perch of only half a pound weight. Mr. W. Thompson found 101,935 ova in a Lump-sucker (*Clyopterus lumpus*) of fifteen inches in length, and the Cod-fish is said to produce several millions.

In general, with the deposition of the spawn the care of the parents for their future offspring terminates; but this is not invariably the case. The statement of Aristotle that there was a fish (*Phycis*) in the Mediterranean which makes a nest and deposits its spawn therein has been confirmed; and Olivi adds, that the male guards the female during the act of oviposition, and the young fry during their development. Dr. Hancock has observed similar habits in some Demerara fishes called " Hassars." Both male and female remain by the side of the nest till the spawn is hatched, with as much solicitude as a hen guards her eggs; and they courageously attack any assailant. Hence the negroes frequently take them by putting their hands into the water close to the nest; on agitating which, the male Hassar springs furiously at them, and is thus captured."!

But we need not go so far as the West Indies, to find

Annals Nat. Hist. vol. iii. p. 44, f Quoted in Owen's Lectures. A nest of the Hassar, with the spawn and the parent fish, is in the Museum of the Royal College of Surgeons, London.

VOL. u. B examples of fishes constructing nests, and evincing a remarkable degree of care and anxiety for their young. The observations of Mr. Couch prove, that, on our own shores, " nests are built, in which the ova are deposited, and over which the adult fish will watch till the young make their escape." On one occasion this gentleman visited daily for three weeks a nest of the Fifteen-spined Stickle-back (*Gasterosteus spmacliia*), formed of sea-weed and the common coralline, and invariably found it guarded; nor would the old fish quit its post so long as he remained.

MEANS OF ESCAPE, DEFENCE, AND ATTACK, In some tribes safety is to some extent secured by the colour of the skin being inconspicuous. It was an old belief, when the real fructification of the ferns was unknown, that the possession of the seed gave supernatural powers of concealment; and hence Shakespeare says: " We have got the fern-seed; we walk invisible." Without possessing the fern-seed, there are certain fishes that enjoy, to some extent, the gift which it was supposed to bestow; and such fishes are living in great abundance on our own shores. I allude to some of the most common flat-fishes. Let any one try to see them as they lie upon the bottom, and he will be convinced it is not an easy matter. When in motion they are of course detected, and occasionally the white side of the body shows for an instant as they glide along; but as soon as they stop, and by the action of the fins have settled down into the sand, they are so similar in colour to the surface on which they rest that they escape detection, unless the eye has watched the movement. All parts of the beach, are not, however, of the same material, and therefore are not of the same colour; but, whatever it may be, the upper surface of the fish exhibits a correspondence which is very remarkable. We have seen it of a uniform dark tint, similar to that of the muddy bottom on which the fish had been found; while on others it was of a mottled or pepper-and-salt colour, like the gravel of the little bay in which it had been captured.

The Flying-fish springing into the air when pursued by the Bonito is an example of a different mode by which danger is avoided. Others, however, do not content themselves with

Notes on the Nidification of Fishes, by R. Q. Couch, Esq. published in " The Zoologist," vol. ii. p. 795. 1844.

concealment or escape, but wield with energy their peculiar weapons of defence. The Skate has a tail armed with sharp spines: the point of the nose and the base of the tail are bent towards each other, and the tail when lashed about in all directions, is capable of inflicting severe wounds. The Weever (*Trachinus draco*) is furnished with spines on the gill-cover and on the first dorsal fin, which have the power of inflicting severe wounds, and even of imparting a venomous secretion. This power, which has been questioned by modern writers, was well known to the ancients, though they attributed venomous powers to some species which are certainly harmless.

' Cruel spines

Defend some fishes, as the Goby, fond Of sands and rocks, the Scorpion, Swallows fleet, Dragons and Dog-fish, from their prickly mail Well named the spinous. These in punctures sharp, A fatal poison from their spines inject." OSSIAN.

Pennant says that he has seen the lesser Weever direct its blows with as much judgment as a fighting cock.

The Picked or Spined Dog-fish (*Acanthias vulgaris*) is distinguished from all other Sharks by a single spine placed in front of each of its two dorsal fins. " This fish," says Mr. Yarrell, " bends itself into the form of a bow, for the purpose of using its spines, and by a sudden motion causes them to spring asunder in opposite directions; and so accurately is this intention effected, that if a finger be placed on its head, it will strike it without piercing its own skin."

These spines are perfectly developed in the young fish prior to birth, and Mr. Ball has made known to us a beautiful provision by which they are prevented at that time from lacerating the mother. They are each " covered at the point with a small knob of cartilage, fastened by straps of the same material, passing down one on each side of the three sides of each spine, in such a manner as evidently to become easily detached at birth, thus allowing the little animal (like the goddess of classic fable) to commence life effectively armed, "t

Dr. G. J. Allman, *Annals Nat. Hist.* vol. vi. p. 161. He had suffered acute pain from a wound inflicted by the spine attached to the gill-cover of the Weever.

t *Proceedings of the Royal Irish Academy*, 27th April, 1846. Mr. Ball exhibited at the same time two perfectly formed young, which he had taken from the mother on the 30th of the preceding November.

The common Stickle-back (*Gasterosteus*, Fig. 187) of our

Fig. 187. STICKLE-BACK.

streams seems to be provided with a weapon, which to its opponents would prove no less formidable. At the lower surface of the body, it has a stiff, sharp spine, which can be erected at pleasure, and so firmly that it may be said, in military phrase, to " fix bayonets."! The Stickle-back is an irritable and pugnacious little fellow; and with this bayonet of his has been seen to rip up the belly of an unfortunate antagonist, so that he sank to the bottom and died of his wound.

An active species of Shark has the teeth within its mouth small and obtuse, and wholly inadequate to destroy the prey on which it subsists; but this deficiency is compensated by a singular and formidable weapon, with strong lateral teeth with which the front of the head is provided. Its saw-like edge has gained for its owner the appropriate name of Saw-fish (*Pristis*, Fig. 188).

The Sword-fish (*Xiphias gladius*) has occasionally been taken upon the British coasts, and is furnished with a weapon, more formidable than perhaps any other species. Daniel, in his "Rural Sports," states that a man while bathing in the Severn, was struck by, and actually received Fig. 188. SAW-FISH, his death-wound from a Sword-fish. The

Called Sprittle bag in the North of Ireland Pinkeen in the South, f Drummond's *Letters to a Young Naturalist*.

elongated upper jaw (Fig. 189) forms the sword, which is frequently found three or four feet in length. The fish occasionally attains a length of more than twelve feet,

and a weight of more than four hundred pounds. It is said to entertain great hostility to the whale; and some of them will join in stabbing it below, while the Fox-sharks will fling themselves several yards into the air, and descend upon the back of their unhappy victim. It is a commonly received notion, that it is in consequence of mistaking the hull of a ship at sea for a whale that the Sword-fish occasionally thrusts his sword-like beak into the vessel.

Fig. 189. SWORD-FISH.

The force with which this is done must be very considerable; many museums contain planks thus pierced either by the Sword-fish or others nearly allied to it. A portion of its sword, about nine inches in length and two inches diameter, was sent to the Belfast Museum, f taken from the *Euphemia*, a vessel which had become leaky on her passage to Brazil. It had been driven not only through the copper sheathing, but also through nine inches of the solid timbers. Other instances are recorded of vessels having suddenly sprung a leak, and being with difficulty got into port, the Sword-fish having been the origin of the calamity.

Fig. 190. ELECTRIC SILURUS.

But a still more remarkable mode of defence is exercised by some species of fish, in the power they possess of giving a severe electric shock. One of these is the electric *Silurus* or *Malepterurus* of the Nile (Fig. 190), a fish to which the

Yarrell, p. 145.

f Thompson, in *Annals of Natural History*, vol. xiii. p. 235.

Arabs give a name signifying thunder. Another is the *Torpedo* or Electric Ray of our own shores (Fig. 191); and a third is the *Gymnotus* or Electric Eel of the South American rivers, whose shock is sufficiently powerful to stun and even destroy horses. Humboldt gives a most graphic picture of the scene attending their capture; the livid yellow Eels swimming near the surface and pursuing their enemies, the groups of Indians surrounding the pond, and the horses with their manes erect and eyeballs wild with pain and fright, striving to escape from the electric storm which they had roused, and driven back by the shouts and Fig. 191 TORPEDO, long whips of the excited Indians.

VITALITY. There are some fishes which die almost immediately when taken out of the water, and others which exhibit symptoms of life after a lapse of several hours. In reference to this subject Mr. Yarrell remarks " that those fish that swim near the surface of the water have a high standard of respiration, a low degree of muscular irritability, great necessity for oxygen, die soon almost immediately when taken out of the water, and have flesh prone to rapid decomposition. On the contrary, those fish that live near the bottom of the water have a low standard of respiration, a high degree of muscular irritability, and less necessity for oxygen; they sustain life long after they are taken out of the water, and their flesh remains good for several days."t The phenomena connected with this law are highly interesting, and excite the attention of the most incurious. Mackerel are so perishable that they are permitted to be cried through London for sale upon the Sunday. Herrings die so instantaneously on their removal from the water, that the saying "dead as a herring," has become proverbial. Perch, on the contrary, live for some hours: " They are constantly exhibited in the markets of Catholic countries, and, if not sold, are taken back to the ponds from which

they were removed in the morning, to be reproduced another day." j The Anglesey Morris, a small fish of rare occurrence, has been known to survive after being

Milne Edwards' "Elemens," p. 281. Yarrell, vol. i. p. 3. Idem, vol. i. p. 22.

wrapped in brown paper, and carried for three hours in a person's pocket. The Carp is so exceedingly tenacious of life, that it is a common practice in Holland to keep it alive for three weeks or a month, placed in wet moss, and in a net kept in a cool place. A little water is occasionally thrown over the net, and the fish are fed with bread steeped in milk.

ERRORS AND TRADITIONS. To those who now enter on the study of fishes, with access to the stores of knowledge accumulated by earlier labourers, and having for their guidance the light reflected from other departments of science, the ideas with which some species of fish have been associated cannot but seem strange, incongruous, and unreasonable. But this assumption of superiority is one that a wider range of study assuredly dispels; and it teaches us, at the same time, to hold our own views with humility, seeing how great were the errors of inquirers who were certainly not less able nor less intelligent. The subject is one to which we can only advert, yet it cannot but prove instructive.

The Mackerel Midge, one of the most diminutive of our native fishes (*Motella glaucd*), is only about an inch and a quarter in length. "This seems," says Mr. Couch, "to be one of the species spoken of by the older naturalists under the name of *apua*, and which, from their minute size, and the multitudes in which they sometimes appeared, they judged to be produced by spontaneous generation from the froth of the sea, or the putrefaction of marine substances."! The notions with respect to the origin of Eels were not less fanciful. Aristotle believed that they sprang from mud; Pliny, from fragments which were separated from their bodies by rubbing against rocks; others supposed that they proceeded from the carcasses of animals; Helmont believed that they came from May-dew, and might be obtained from the following process: "Cut up two tufts covered with May-dew, and lay one upon the other, the grassy sides inwards, and thus expose them to the heat of the sun; in a few hours there will spring from them an infinite quantity of E els." Horse-hair, from the tail of a stallion, when deposited in water, was formerly believed to be a never-failing source of a supply of young E els. J The ear-bones of the Maigre (*Scioena aquila*), a fish which attains the length of five or six

London's Mag. Nat. Hist. vol. vi. p. 330. f Vide Tan-ell, vol. ii. p. 193. Idem, vol. ii. p. 289.

feet, and has been occasionally taken on the British shores, were supposed to possess medicinal virtues. ' According to Belon, they were called cholic-stones, and were worn on the neck, mounted in gold, to secure the possessor against this painful malady: to be quite effectual, it was pretended that the wearer must have received them as a gift if they had been purchased, they had neither their preventative nor curative power."

The Opah, or King-fish (*Lampris guttatus*), a beautiful species of rare occurrence in the British seas, is by the Chinese termed *Tai*, and is esteemed as the peculiar emblem of happiness, because it is sacred to *Jebis* or *Neptune*. The John Dory (*Zeus faber*, Fig. 191) belongs to the same family,

Fig. 191. JOHN DORY.

and contends with the Haddock (*Morhua ceglafinus*) for the honour of bearing the marks of St. Peter's fingers each being-supposed to have been the fish out of whose mouth the Apostle took the tribute money, leaving on its sides, in proof of the identity, the marks of his finger and thumb.

In many of the ports of the Mediterranean, the Dory is hence called " St. Peter's Fish." The fishermen of the Adriatic term it *il Janitore*, "the gatekeeper," a word which Cuvier et Valenciennes. *Histoire Naturelle* (les Poissons, vol. x. p. 6.

may have given origin to the English name; or it may have been derived from the French *doree* or *jaune doree*, having reference to its peculiar golden colour.

We might greatly enlarge these notices of traditionary lore, as applicable to fishes, but shall merely mention one other example. The *Remora* (*Echeneis remora*, Fig. 192) is re-

Fig. 192 REMORA.

markable for an adhesive or sucking disc, which covers the upper part of the head, and enables it to adhere to the body of another fish, or to the bottom of a vessel. But so great were its fabulous powers, that it was said to be able suddenly to arrest a vessel, even in her most rapid course.

CLASSIFICATION. To Cuvier we are indebted for that classification of fishes which is most generally adopted. It is founded upon the nature of the skeleton, and on the structure and position of the fins.

The following table exhibits Cuvier's arrangement:

OSSEOUS FISHES,

OR THOSE WITH THE SKELETON OF BONE.

I. ACANTHOPTERYGII, or fishes with spiny rays in the fins. Examples Perch, Gurnard. This group is not subdivided except into families, genera, and species.

Malacopteryg'd; or fishes with flexible fin-rays. This group is divided into the three following orders: II. MALACOPTERYGII ABDOMINALES, with the ventral fins beneath the abdomen. Examples Pike, Salmon, Herring.

III. MAL. SUB-BRACHIALES, ventral fins beneath the pectoral. Examples Cod, Whiting, Ling.

IV. MAL. APODES, ventral fins absent. Examples Eel, Conger Eel.

V. LOPHOBRANCHII, the gills arranged in tufts. Example Pipe-fish.

VI. PLECTOGNATHI, jaws as if soldered together. Examples Globe-fish, Trunk-fish.

CARTILAGINOUS,

OR THOSE WITH THE SKELETON OF CARTILAGE.

VII. STURIONES Sturgeons Branchiae pectinated (comb-shaped), free,-with one large aperture.

VIII. PLAGIOSTOMI Sharks and Kays. Branchiae pectinated, fixed; gill apertures distinct and transverse.

IX. CYCLOSTOMI. Lampreys. Branchia3 purse-shaped, fixed; gill apertures distinct and circular.

In some fishes, as the Skate and the Shark, the skeleton is cartilaginous, or composed of gristle, being so far analogous to the skeleton of the young of the mammalia before

the earthy particles which convert the cartilage into bone have been deposited. In others, as the Perch, the Trout, and the Cod, the skeleton is formed of bone. This points out an obvious division of fishes into two primary groups the cartilaginous and the bony. The latter admit with facility of further division. If we examine the Perch and the Trout, we find the bones of the same material, and the gills formed after the same model. The back in each is surmounted by two fins, but the resemblance ceases when we come to examine the structure of these organs. In the Perch, the first of these dorsal fins, or that which is next to the head, is composed of stiff spines united by a membrane, as shown in the annexed figure (Fig. 193), or in that of the entire fish (Fig. 181); while in the Trout the corresponding fin is formed of soft flexible rays, dividing into branches. A difference of the same kind is observable in the anterior or front portion of some of the other fins: the tail fin consists in both cases of the most flexible rays. This difference in the dorsal fin (Latin, *dorsum*, the back) may seem a very trivial matter; but it enables the naturalist to divide the osseous or bony fishes into two orders those with the fins partly of hard or spiny rays (*Acanthopterygii*), and those with the fins entirely of soft rays (*Malacopterygii*) These orders are again subdivided, according to the presence or absence of certain fins the difference in their relative positions the variety in the structure of the gills and gill-covers, and other details of secondary importance. By these characteristic distinctions the ichthyologist, or in other words the naturalist who makes fishes his peculiar study, arranges them in groups, distinguished as orders, families, and genera.

Those scientific terms are both derived from Greek words, signifying, in the one case, fins of sharp or spinous rays, and in the other, fins soft or of flexible rays.

Fig. 193. DORSAL FIN.

FROM the peculiar structure of the skeleton, these form an interesting group, holding a place between the Cuttle-fish, in which there is hut the rudiment of a skeleton, and the osseous fishes, in which the vertebrated structure in this class of animals reaches its full development. Among them there is great diversity. One little fish, of rare occurrence, the Lancelet (*Ampliioxus lanceolatus*), which is not much more than an inch in length, has no skeleton, properly so called, hut merely a membraneous thread; in the Lamprey the divisions of the vertebrae are marked, so that they resemble beads placed on a string; in the Shark and the Sturgeon, the divisions of the vertebra are complete.

PETROMYZHLE. The family of the Lampreys (Fig. 194)

Fig. 194. RIVER LAMPREY.

comprises the Lancelot, the fish just mentioned. Some of them dredged up in deep water, off the southern coasts of England, by Mr. Mac Andrew, were exhibited by Professor Edward Forbes, at the Southampton meeting of the British Association, September, 1846. They have, ere now, been ranked with the Mollusca, and exhibit peculiarities of a nature so remarkable as to be objects of the highest interest to the

That is, the family of the " Stone-suckers," an appellation bestowed on them because, by means of their circular mouths, they can adhere to stones. Like other terms, it is derived from two Greek words.

comparative anatomist. These little fishes had devoured some larger ones of a different species, which had been confined in the same vessel with them, eating off

their hodies what they required at one time, and returning, in the Abyssinian fashion described by Bruce, for another supply when wanted.

Fig. 195. EGG-BAG, WITH YOUNG SHARK.

SQUALID;, **RAIID E.** The Sharks and the Rays, though differing so much in external form, belong to a group of fishes of which the gills are fixed, and the water, passing through the mouth, escapes from the gills by a series of longitudinal incisions. The ova, which are few in number, are not deposited on the sand or gravel, but each egg is enclosed, for greater safety, in a horny case, attached by long tendrils to the larger sea-weeds; and among the Sharks of the largest size, some bring forth their young alive. The empty egg-cases are frequently found on the sea-shore, and are well known by the name of " sea-purses," "mermaids' purses," and other local terms. The longer and narrower-shaped (Fig. 195) belong to the Sharks and Dog-fishes; the broader and shorter ones to the Skates or Rays. Water is admitted into them by means of a slit at each end of the purse. In two large clusters dredged up in Strangford Lough, and sent to the Belfast Museum, the cases were obviously of three very distinct ages, the most recent being yellowish, semi-transparent, and the contents resembling those of a newly-laid hen's egg. Our figure, which is copied from that given by Mr. Yarrell, represents the case laid open, and the young Dog-fish attached to the i yolk," or membraneous bag of nutriment, which is gradually absorbed as the growth proceeds.

They were regarded as the ova of the Large-spotted Dog-fish. W. Thomson, in *Annals Nat. Hist.* vol. xiv. p. 23.

The history of fishes furnishes many curious examples of certain kinds being held in high estimation in some places as food, and quite despised in others. This is the case with the Rays, of which there are eight native species. In the London market they are much valued, and in some parts of the coasts they are considered delicate and well-flavoured; while, in other localities, they are not used at all, or employed only as bait for catching crabs and lobsters. Colonel Montagu mentions a similar fact respecting the Sand-eel, known as the Sand Launce (*Ammodytes Lancea*). At Teignmouth it was in great request as food, while on another part of the south coast of Devonshire it would not be eaten even by the poorest people.

The Dog-fish of our own coasts belong to the family of the Sharks (*Squalidce*). In these rapacious fishes " as among the truly predacious birds, the females are larger than the males; and almost all the species have received some name resembling Beagle, Hound, Rough Hound, Dog-fish, Spotted Dog, c. probably from their habit of following their prey, or hunting in company or packs. All the Sharks are exceedingly tenacious of life. Their skins, which are of very variable degrees of roughness, according to the species, are used for different purposes; in some instances by cabinet-makers, for bringing up and smoothing the surfaces of hard wood."

The Small-spotted Dog-fish (*Scyllium Canicula*, Fig. 196),

Fig. 196. SMALL-SPOTTED DOG-FISH.

the species most abundant on our shores, is an object of great dislike to fishermen, who try in various ways to avenge the injury which they believe it causes to their fishing. In tropical seas, the capture of the White or of the Blue Shark, the terror of mariners, is always to them a source of great exultation. The first act of the sailors, when their enemy is hauled up on

Yarrell, vol. ii. p. 369.

the deck, is to chop off its tail, as danger is to be apprehended from the great strength with which it is used. Captain Basil Hall gives a most animated and seamanlike description of the entire scene.

Some of the Sharks attain a great size. The Basking Shark, a species found off these coasts, has been known to measure thirty-six feet in length, and is one of the largest of the true fishes, t The Blue Shark has been celebrated for its affection for its young; and the belief yet prevails that the young are accustomed to seek safety from danger by entering the mouth of the parent fish, and taking shelter in its belly. That they have been found alive in the stomach is admitted; but that they went there voluntarily, or for safety, seems more than doubtful. J

A beautiful example of beneficent design is afforded by a peculiarity of structure observable in the young of Sharks and Skates, whilst still imprisoned in the egg-case. From the gills there are projecting filaments; each of these contains a minute blood-vessel, and serves thus to expose the blood to the purifying action of the water within the horny egg-case. These appendages, like those of the Tadpole hereafter mentioned, are only temporary; but they fulfil, at an early period of growth, the function which is afterwards so efficiently performed by the gills.

A more striking example of providential care is perhaps afforded by the arrangement which furnishes to the Sharks the means of keeping their formidable array of teeth (Fig. 197) fit to execute at all times their fearful office. They must be liable to be displaced and broken, and if fixed in sockets, as our teeth are, and no means provided for a successive series, it is obvious that these formidable monsters of the deep would in time perish, from inability to seize their prey. But this

Fig. 197. HEAD OF SHARK.

Fragments of Voyages and Travels. Second Series, vol. i. p. 267. t Yarrell, p. 39G. f Tarrell, p. 381.

is avoided by the teeth not being fixed in sockets, but attached to a cartilaginous membrane. The first row of teeth stands erect, the others are laid flat behind. The membrane continues to grow, and advance forward, the outer teeth drop out, the membrane itself is thrown off or absorbed, and the row which was originally second takes the place of the first, all the teeth in it standing erect, until, in the course of time, they make way for a third series, which is followed by others in succession.

STURIONIDE. The only remaining fish we shall mention belonging to the cartilaginous group is the Sturgeon (Accipenser Sturio, Fig. 198), and it approaches to the other

Fig. 198. STURGEON.

families of fishes in being oviparous, and in having the gills free. Its external appearance is striking, and the series of bony plates upon the surface of the skin is very remarkable.

In comparing the figures of the Sturgeon (Fig. 198), and of the Dog-fish (Fig. 196), with that of the Perch (Fig. 181), the appearance presented by the tail is extremely different. In the perch, the vertebral column ceases at the tail-fin, which, if the line of that column were continued, would be divided by it into two equal parts. In the Sturgeon and others, the vertebral column is continued into the upper portion of that

fin, and symmetrical appearance in the organ is therefore wanting. This is one of the obvious external characters by which the cartilaginous fishes may be distinguished from the osseous. In remote periods of the earth's history this peculiarity of structure appears to have prevailed universally: it is found in every fossil fish whose remains are preserved in the magnesian limestone, and in strata of older formation.

The Sturgeon when caught in the Thames, within the jurisdiction of the Lord Mayor, is considered a royal fish; the term being intended to imply that it ought to be sent to the king. One taken in 1833, in Scotland, measured eight feet six inches in length, and weighed 2031bs. Pennant

Yarrell, vol. ii. p. 362.

mentions the capture of one in the Esk, weighing 464 lbs. In the northern parts of Europe, where the fish is more abundant, caviare is made of the roe of the female, and isinglass from the dense membrane forming the air-bladder.

OSSEOUS FISHES,

WITH THE RAYS OF THE FINS FLEXIBLE.

Our plenteous streams a various race supply,
The bright-eyed Perch, with fins of Tyrian dye,
The Silver Eel, in shining volumes roll'd,
The Yellow Carp, in scales bedrop'd with gold,
Swift Trouts, diversified with crimson stains,
And Pikes, the tyrants of the watery plains." POPE.

HAVING already noticed the Globe-fish (Fig. 179) and the Trunk-fish (Fig. 180), which are members of a group connected by some points of structure with the osseous, and by others with the cartilaginous fishes, we proceed to a small but interesting order (Lophobranchii) in which the gills are arranged like little tufts. To this belongs the Hippocampus or Sea-horse (Fig. 199), and the Pipe-fishes (Syngnathidae), one of which has been noticed in connexion with its powers of movement (p. 222). This species is the largest of our native Pipe-fishes (*S. acus*, Fig. 182), and is furnished with a marsupial pouch. The idea of such a pouch is connected with that of its female. We know that it is thus the female Kangaroo carries and protects her young; but in natural history we are for ever meeting such strange occurrences, that it has been well said, Fig. 199. "the naturalist has no need to invent; Nature *ro-HIPPOCAMPUS. mancesitforhim.*" In the Pipe-fish, contrary to what we find in other tribes of animals, the marsupial pouch belongs to the male. The sexes come together in the month of April; the ova pass from the female, and are transferred into the sub-caudal pouch of the male, the valves of the pouch

They belong to the Order Plectognathi, of Cuvier, characterised by having the jaws as if soldered together.

immediately closing over them. "In the month of July, the young are hatched and quit the pouch, but they follow their father, and return for shelter into their nursery when danger threatens."

We have taken Pipe-fishes very abundantly by means of a small dredge towed over an expanse of mud banks, thickly covered with grass-wrack (*Zostera*). Here there were doubtless small mollusca in abundance, affording a kind of food well adapted for the long tubular jaws of the Pipe-fishes.

Anguillidae, the family of the Eels. The pectoral fins in fishes are the representatives of the members which we call the arms in monkeys, and the wings in birds. The ventral fins are, in like manner, regarded as the representatives of the legs and feet. In the Eel tribe the ventral fins are wanting, and hence the term Apodes, a word signifying "without feet," has been applied to denote this peculiarity.!

The two species of Sand-eels are alike in their habit of burying themselves in the moist sands of the sea-shore; and we can speak from experience of the fun, frolic, and activity that prevailed when, on a summer night by a bright moon, some of our merry school companions turned up the sand, while others darted at each fish as it showed its silvery side for a moment in the light and then disappeared. At Dundrum Bay, County Down, and on other parts both of the Irish and English coast, they are taken in such abundance as to constitute a valuable article of food. The smaller and more common species (*Ammodytes Lancea*) is usually from five to seven inches in length, and offers a great contrast to another member of the same family, the Conger Eels of our coasts, which sometimes attains the weight of 100 or even 130 lbs. and measures more than ten feet in length. J There is a notion yet current that common Eels going into the sea remain there, and grow into Congers: an idea as unfounded as that of the child who supposes that ducks will grow into geese. The permanence of species is a truth which increasing knowledge every day confirms.

Three species of freshwater Eels are described as British. Some of these remain permanently throughout the year in certain ponds or rivers, and there deposit their spawn; but

Owen's Lectures, p. 804.

f The Order is named *Malacopterygii Apodes*.

J Yarrell, ii. p. 306.

this is the exception to the rule. The Eels may, in general terms, be described as making a migration to the sea in the autumn of the year, for the purpose of spawning. It is at this time that they are taken in the largest quantities for the table. In the north of Ireland, one great place for their capture is Toome, on the Lower Bann, a river connecting Lough Neagh with the sea. The fishermen there assert that the Eels (*Anguilla acutirostris*) avoid the moon-light, and that "a rim" of fish takes place only when the night is dark, and that even a flash of lightning will stop their progress. We are informed by Mr. Finiston, of Toome, that he has "completely stopped their progress, by placing three large lamps, so that the rays of light fell on the surface of the water, directly over the entrance to the net." 1 A "run," as it is termed, occurs only two or three nights in the season, but the quantity then taken is very considerable. So many as 45,000 small Eels have been taken in one night; and there are generally about sixty middle-sized Eels and ten large to each thousand of small. They are taken in nets, which may be compared in shape to sugar-loaves with the tops cut off, each from fourteen to sixteen yards long, and placed between weirs. At an early period of the summer it is an interesting sight, at the Cutts, near Coleraine, on the same river, to mark the thousands of young Eels there ascending the stream. Hay ropes are suspended over the rocky parts to aid them in overcoming such obstructions. At such places the river is black with the multitudes of young Eels, about three or four inches long, all acting under that mysterious impulse that prompts them to push their

course onwards to the lake. " There is no doubt that Eels occasionally quit the water, and, when grass meadows are wet from dew or other causes, travel during the night over the moist surface in search of Frogs and other suitable food, or to change their situation."

Eels have been known to be frozen and again revive, yet they seem in other ways very susceptible of cold. They are not found in the arctic regions nor in the rivers of Siberia. In our latitudes they take shelter from the inclemency of the winter by burying themselves in the mud. But this does not always protect them. In February, 1841, during a hard frost, large quantities of dead Eels, of the common sharp-nosed

The family of this gentleman were for many years the lessees of the fishery at Toome.

species, came floating clown the Lagan, and were taken in great abundance about the quays and wharfs of Belfast. The temperature for three days, as observed by Mr. Thompson, was then 27-J0, which was ten degrees higher than during three successive days in the preceding month, when none were known to have suffered from cold; but at the time the Eels were killed a strong easterly wind dried up the moisture of the banks, and probably occasioned their death by the extreme cold arising from evaporation. The Conger Eels near Cork seem to have suffered from a similar cause at the same time. f

Passing by the Remora (Fig. 192), the representative of another family (Echenei-dce), and whose singular sucking-disc, placed on the crown of the head, has been already referred to (p. 237), we come to a family (Cyclopteridce) in which the ventral fins are not wanting, as in the Eels, but are united beneath the body and form a concave disc, by which the fish can with ease adhere to stones or other bodies. Of this group the Lump-sucker (*Cydopterus lumpus*, Fig. 200) is the best

Fig. 200. LUMP-SUCKER.

known species, as his uncouth shape, red eyes, and body in which bright tints of blue, purple, and orange, struggle for precedence, arrest the attention of the most incurious. We have taken in rock pools the young fish when less than an inch in length, and by changing the sea-water regularly, have kept them alive for several days, and have thus had opportunities of observing the rapidity with which they could adhere

Annals of Natural History, 1841, vol. vii. p. 75. f F. M. Jennings, Idem, p. 237.

Fig. 201. PLAICE.

to the sides of the glass vessel in which they were kept, or cast themselves free and pursue their course. Many of these marine creatures are highly interesting objects for observation, and after being kept for a clay or two, may be returned to the sea uninjured; so that death is not the necessary consequence of their temporary imprisonment.

Pleuronectidce. To this family belong the Plaice (*Platessa vulgaris*, Fig. 201), the Flounder (*Platessa jlesus*), the Sole (*Solea vulgaris*), and other well-known flatfish. Few are perhaps aware of their importance, regarded merely in the light of a marketable commodity. It is stated that for Turbot (*Rhombus maximus*, Fig. 202) brought to the London market, the Dutch are paid 80,000 a-year; and that the Danes receive from 12,000 to 15,000, a-year for sauce for this luxury, extracted from one million of lobsters taken on the shores of Norway.! The Turbot is considered to have been the *Rhombus* of the ancient Romans; and Juvenal alludes in his " Satires " to one of

enormous size, taken in the reign of Domitian, who ordered a consultation of the senate, to devise the best mode of bringing it to table:

"No vessel they find fit to hold such a fish, And the senate's convoked to decree a new dish."

The next family (Gadidce) contains a number of species which yield a most abundant supply of nutritious food, and give employment even on the British coasts to many thousands of hardy boatmen and mariners. It includes the Cod (Fig. 203), the Haddock, the Whiting, the Hake, the Ling, and

The term is compounded of two Greek words, signifying to swim on one side, which is the well-known movement of these fishes, f *Encyclopaedia Britannica*.

Fig. 202. TURBOT.

others, The common Cod is so very voracious, that five-and-thirty crabs, none smaller than half-a-crown, have been

Fig. 203. COD.

taken out of the stomach of one fish. But this very voracity makes the capture more easy, as almost any bait is acceptable. The great value of the Newfoundland Cod fishery is well known. The produce in 1836 was 860,354 quintals of fish,)" each quintal being a hundred pounds. The oil which they yield is also a product of commercial and medicinal importance. Clupridce, the family of the Herring. Every reader of a newspaper must be familiar with the term, "Whitebait dinner," as indicating a repast held in high estimation by the Lord Mayor and Aldermen of London, and by the learned Fellows of the Royal Society; and for which the ministers of the Sovereign pay annually a visit to Blackwall. This little fish (Fig. 204), so prized for its delicious flavour, was formerly

Fig. 204. "WHITEBAIT.

By Mr. Couch. Yarell, vol. ii. p. 145.

f *Penny Cyclopaedia*.

j In the Cod, the Haddock, the Whiting, and other fishes belonging to the families we have been considering, the ventral fins are immediately below the pectorals. In the Herring, the Salmon, the Pike, and others belonging to families now about to be enumerated, the ventral fins are attached to the abdomen, and are situated far behind the pectorals. This circumstance enables us to divide such of the soft-rayed fishes (malacop-terygii), as are possessed of ventral fins into two groups the abdominal and sub-brachial, according to the situation of the fins.

"Feasts which would have made the ichthyophagous epicures of old die of envy." FORBES AND SPKATT'S LYCIA, vol. ii. p. 91.

supposed to be the young of the Shad, but has now had its claims established by Mr. Yarrell to rank as a distinct species (*Clupea alba*). The Sprat (*Clupea sprattus*), another member of the same family, is valued, not so much for its delicacy as for its extreme abundance. It is taken during the winter months; the coasts of Kent, Essex, and Suffolk being those which are most productive. It is not used only as an article of food: after that demand has been fully supplied, the numbers are so great that the fish is used as manure. Many thousand tons are in some seasons sold to farmers, at sixpence to eightpence per bushel, for this purpose; forty bushels of Sprats being spread over an acre of land.

The Pilchard (*Clupea pilchardus*), another of the family, is even more important. The number of persons to whom this fishery gives employment on the Coast of Cornwall has been estimated at 10,521: and the capital invested in boats, nets, and cellars for curing, at 441,215. The quantity taken is sometimes incredibly large, "An instance," says Mr. Yarrell, ' has been known where ten thousand hogsheads have been taken on one shore, in one port, in a single day; thus providing the enormous multitude of twenty-five millions of living creatures drawn at once from the ocean for human sustenance, "f The vast multitudes in which they occasionally appear realise the description of the poet:

"Forthwith the sounds and seas, each creek and bay, With fry innumerable swarm, and shoals Of fish that with their fins, and shining scales, Glide under the green wave, in sculls that oft Bank the mid sea." MILTON.

Ranking still higher as an object of national importance is the Herring fishery, which gives occupation to thousands around the British coasts, and supplies to hundreds of thousands a cheap and favourite article of diet. The space to

Yarrell.

f This calculation is made on the supposition that each hogshead contains 2,500 fish, which is about the average quantity. It is stated by K. Q. Couch, Esq. in a paper read by him before the Penzance Natural History and Antiquarian Society, that the number of hogsheads exported for the last ten years amounts to 176,168, and upwards of a third more is used for home consumption. During the present year, 33,959 hhds. have been exported 3,052 of which were sent to Genoa; 8,499 to Leghorn; 1,368 to Civita Vecchia; 13,309 to Naples; and 7,731 to the Adriatic Penzance Gazette, IQth Feb. 1847.

which we are necessarily restricted compels us to limit our notice of this well-known fish to one single point in its economy its appearance on our coasts.

By Pennant, the approach of the Herring (*Clupea harengus*) has been described as that of a mighty army, which, coming from the arctic circle, divides at the Shetland Isles into two great bodies, one of which fills the creeks and bays of the east coast of Britain, while the other, passing along the west, separates towards the north of Ireland into two divisions 4 'one of which takes to the western side, and is scarcely perceived, being soon lost in the immensity of the Atlantic; but the other, which passes into the Irish Sea, rejoices and feeds the inhabitants of the coasts that border on it,"

This account, though circumstantial, is altogether incorrect. The Herring does not abound in the arctic seas; and the division of the mighty army into brigades which pursue their way along the eastern and western shores, is purely imaginary. The Herring does perform a migration, but of a limited range. It comes to the shores for the purpose of spawning; the increased temperature and greater supply of oxygen being necessary for the development of the young. The ova being deposited, the Herring forsakes the shore for the deeper water, where it habitually dwells. It is not a visitant from a distant region, but a constant dweller in our own seas. It comes to the coast for a specific purpose, and that purpose being fulfilled, it again retreats to the deep water.

The Pilchard was, like the Herring, supposed to migrate from remote seas. Modern research has stripped the history of both fishes of much that was marvellous; but the

mere emotion of wonder which is thus destroyed, is on a little reflection succeeded by one of a deeper, more reverential, and more abiding character. Under the impulse of the law by which certain species of fishes are, at successive seasons, impelled to approach the shores, the most effectual means are provided for the continuance of each of the several kinds; and while the perpetuation of the species is thus secured, man is furnished with a varied and successive supply of food, abundant, nutritious, and brought from the depths of the ocean within the sphere of his activity and skill. This constantly recurring yet ever varying phenomenon has in its nature nothing of chance. It is a beneficent law, and reveals a beneficent Author.

Salmonidæ. The Salmon is the acknowledged head of a well-known family of fishes. Among them is one that by common observers is referred to a different race, and is not unfrequently called the "Freshwater Herring." We refer to the Pollan (Fig. 105), an Irish species found in Lough Derg,

Fig. 205. POLLAN.

Lough Erne, and Lough Neagh, and first described by Mr. W. Thompson, as distinct from other species of the same genus in Lochmaben, and in the Cumberland lakes. It approaches the coasts in large shoals, not only during spring and summer, but when the autumn is far advanced. In September, 1834, the greatest "take" of Pollan ever recollected at Lough Neagh took place, where the Six-mile-water enters the lake. "At either three or four draughts of the net, 140 hundreds, 123 fish to the hundred or 17,220 fish, were taken. More were taken at one draught than the boat could with safety hold, and they had, consequently, to be emptied on the neighbouring pier. They altogether filled five one-horse carts, and were sold on the spot at the rate of 35. 4d. a hundred, producing 23 65. 8d. They are brought in quantities to Belfast, and when the supply is good, the cry of 'fresh pollan' prevails even to a greater extent than that of 'fresh herring,' though both fishes are in season at the same period of the year." In the nets with the Pollan are taken the Common Trout (*Salmo fario*) and the Great Lake Trout (*Salmo ferrox*). There

The local name is Pollan, which has been retained in the scientific appellation, *Corregonus Pollan*. The information given respecting the fish is entirely derived from Mr. Thompson's researches, as republished in *Yarrelps Fishes*, 2d edition, vol. ii., p. 156. The figure is copied from that originally published in *Annals of Natural History*, vol. ii.

f The English long hundred is six score, or one hundred and twenty.

is a variety of the former called in the neighbourhood of Lough Neagh the Gillaroo Trout, and said by common rumour to have a gizzard like that of a fowl. This notion must have originated in common observers having mistaken for a gizzard the skin of the stomach, which becomes hardened, possibly from the large numbers of a univalve shell (*Pahidina impura*) used as food. The Great Lake Trout sometimes exceeds a yard in length and thirty pounds in weight. The large individuals are known at Lough Neagh by the name of Buddaghs, and the smaller as Dolachans.

Among the delightful fictions of the Arabian Nights' Entertainments is one of a lake, in whose waters were fishes of four different colours. Local causes seem to act upon the colour of the common Trout, so as to produce effects scarcely less surprising. This fish is distinguished for its bright and speckled skin; but we have seen, at Lough

Katrine, Trout so black, that they seemed as if they had gone into mourning. The author of "Wild Sports in the West" mentions a similar circumstance with regard to the trout of a small lake in the county of Monaghan, the water being bounded on one shore by a bog, and on the opposite by a dry and gravelly surface. On the bog side the Trout are dark and ill-shaped; on the other they are beautiful and sprightly, like those inhabiting rapid and sandy streams. "Narrow as the lake is, the fish appear to confine themselves to their respective limits the red Trout being never found upon the bog moiety of the lake, nor the black where the under surface is hard gravel."

But the brief space which we can devote to the Salmonidae renders it needful that we should proceed at once to the most important of the family, the Salmon (*Salmo salar*).

During the floods of winter and early spring, this fish descends the river to the sea, lean and ill-conditioned, and returns in a few months, plump, well-conditioned, and greatly increased in size, from the abundance of food derived from small Crustacea, fishes, and other marine animals and their ova. It is on their return from the sea for the purpose of spawning that the Salmon are taken. This occurs during the summer and autumn months, the precise time being different in different rivers.

Impelled onwards by the instinct which prompts this migration, the Salmon endeavours to surmount all obstacles that lie in its course, and flings itself over ledges of rock ten feet or more in height above the surface of the water. It is said that at the falls of Kilmorac, in Inverness-shire, the Frazers of Lovat, the lords of the manor, caused this power to be occasionally exhibited in a singular manner for the entertainment of their guests. On a flat rock at the south side of the fall, and close to the edge of the water, a kettle was kept boiling, and the company waited until a Salmon fell into the kettle and was cooked in their presence.

We never witnessed the singular spectacle thus recorded, but can imagine nothing in its way more attractive than the drawing of the nets at the Salmon fishery called the Cranagh, on the Lower Bann, about a mile below the town of Coleraine. As the fishermen pull the net nearer to the shore, the struggles of the fishes in their efforts to escape, and now and then the vigorous leap which sets a captive free, are in the highest degree exciting. During two days which we spent there in June, 1823, the value of the fish taken, estimated at one shilling per lb., exceeded 400. By a relative, who had at that time the care of the fishery, we were informed that on the 5th of July, 1824, four hundred Salmon were taken at one "haul," and three hundred and fifty at the next. The entire weight of the fish captured that day amounted to two tons.

The fish are packed in ice, and are thus brought to market in good condition. But several years ago, when this practice was unknown there, it is said that the enormous number of 1,500 Salmon were taken at a single pull, and sold in Coleraine and the neighbourhood for three farthings per pound.

It was formerly supposed that the young Salmon fry descended to the sea the same season they escaped from the egg, and returned later in the year, their growth having been extremely rapid. But by a number of experiments and observations, made with great care, and ingeniously varied, this has been proved by Mr. John Shaw not to be the case. The young fry does not go down to the sea until after it has completed its second year, nor does it until then assume what Mr. Shaw terms its migratory dress.

What then is its appearance during the earlier period of its existence? From the time it is one inch in length it has in common with different species of Trout the lateral markings that have been considered as characteristic of the

Mndie's British Naturalist.

f Transactions of Royal Society, Edinburgh, 1840.

Parr. These it retains until it has completed its second year, and reached the length of six or seven inches. These markings then disappear the old name is laid aside with the old dress and it is in future known, not as the Parr, hut as the Salmon smolts or fry. The fish, therefore, which has hitherto been called the Parr, and believed to be a distinct species, proves to be merely the early state of the Salmon; and thus one name is struck from our list of native species."

A remarkable fact is mentioned by Mr. Shaw, that " the milt of a single male Parr, whose entire weight may not exceed one ounce and a-half, is capable, when confined in a small stream, of effectually impregnating all the ova of a very large female Salmon."

The young fry are descending the rivers in March, April, and May: a fact referred to in popular couplets:

"The floods of May Take the smolts away."

They most generally return to their native rivers. The fishermen acquire such habits of quick and accurate observation, that they point out with facility one that is a stranger, and name, in most cases, the place from which it came. This we have repeatedly seen them do at the fisheries on the Bann, and so promptly and decidedly, as to show they entertained no doubt on the subject.

Esocidae. The Flying-fish is nearly allied to the present family, that which is represented by the Pike (*Esox Indus*. This is a strong, fierce, active, and voracious fish, of whose audacity many stories are told. Gesner relates that a Pike in the Rhone seized on the lips of a Mule that was brought to water, and that the beast drew the fish out before it could disengage itself. " At Lord Gower's canal at Trentham, a Pike seized the head of a Swan as she was feeding under water, and gorged so much of it as killed them both; the servants perceiving the Swan with its head under water for a longer time than usual, took the boat and found both Swan and Pike dead,"

It was formerly a rare fish in these countries; so much so, that Edward I. fixed its value higher than that of Salmon, and ten times greater than that of the best Turbot or Cod; and, in the reign of Henry VIII. a large one sold for double

Yarrell, vol. i. All the information here given on the Pike is derived from that author.

the price of a house Lamb in February, and a Pickerel, or small Pike, for more than a fat Capon.

"Pliny considered the Pike as the longest lived, and likely to attain the greatest size of any freshwater fish. Pennant refers to one that was ninety years old; but Gesner relates that, in the year 1497, a Pike was taken at Hailbrun, in Suabia, with a brazen ring attached to it, on which were these words in Greek characters: 'I am the fish which was first of all put into this lake by the hand of the Governor of the Universe, Frederick II., the 5th of October, 1230.'" This fish was, therefore, 267 years old, and was said to have weighed 350lbs. The skeleton, nineteen feet in length, was long

preserved at Manheim as a great curiosity in natural history. The lakes of Scotland have produced Pike weighing 55 Ibs. weight; and some of the Irish lakes are said to have afforded Pike of 70Ibs."

Cyprinidce. The family of the Carp includes the Minnow, the Bleak, the Rudd, the Bream, the Tench, the Gudgeon, and other well-known freshwater fishes. The Golden Carp (*Cyprinus auratus*), or Gold and Silver-fishes, as they are more generally called, have been originally imported into these countries, but authors are not agreed as to the precise year. The Carp (*Cyprinus carpio*) itself is also a naturalised species, but introduced at so remote a date that, in the "Boke of St. Albans," printed at Westminster in 1496, it is mentioned: "The Carpe is a dayntous fishe, but there ben but fewe in Englonde."

The Bream is in such repute on the Continent, that an old French proverb says, "he that hath Bream in his pond is able to bid his friend welcome." And it may be inferred from a couplet in Chaucer's Prologue to the Canterbury Tales, that the feeding and eating of Bream was more in fashion in the days of Edward III. than at the present time

"Full many a fair Partrich liadde he in mewe, And many u Breme, and many a Luce in stewe."

To one class of our young readers, it may perhaps be more interesting to know that from the silvery-looking scales of this family of fishes, the material is derived for making the gorgeous necklaces of artificial pearl which are so temptingly displayed in the toy-shops.

Pike.

THE remaining fishes belong to Cuvier's first Order (*Acanthopterygii*). They have the skeleton of bone, and the dorsal fins, as already mentioned (p. 238), supported in part by rays which are spinous and undivided. In all of them the gills are arches, presenting the pectinated or comb-like structure so well known in our most common and valuable fishes.

Labridce. The first family we shall mention is that of the Wrasse, of which there are many species possessing brilliant colours blue, green, orange, and red and one a Mediterranean species, which has been taken on the English coast, has so many bright tints intermingled in his costume, that he is appropriately termed the "Rainbow Wrasse." The Ballan Wrasse (*Labrus maculatus*) is sometimes taken off the rocky parts of the coast of Down and Antrim, measuring about eighteen inches in length. We have heard it called in the Belfast market the "Old Wife." In Plymouth market, the females of the Blue or Grey Skate (*Raia batis*) are called "maids" and "good wives." We have already mentioned the Fishing Frog (*Lophius piscatorius*, p. 226), a species which belongs to another family (*Lophiadce*), and stated that it is also called the Angler. But these are not its only names, for it has as many aliases as other persons of equivocal character, being known as the Sea Devil, and in Scotland by the expressive, though not very euphonious, appellation of "Wide Gab."

Goloidce. Among the Gobies and Blennies of this family, there is one species which brings forth its young alive, and is hence called the "viviparous Blenny." Some are remarkable for their tenacity of life.

Mugilidæ. In connexion with the family of the Mullet, an interesting fact has been established that the *Mugil chelo*, or thick-lipped grey Mullet of Cuvier a species of extreme rarity on the southern coast of England is that which is most abundant on the eastern shores of Scotland, and along the opposite coast of Ireland. In the Bay of Belfast they are very plentiful, especially where the waters of the river Lagan mingle with those of the sea. Mr. Thompson states that, on 1st of May, 1838, 7 cwt. of these fish were taken at a single draught of the net; and on the same night, 9 cwt. were secured by the crew of another boat. A Mullet of large size will occasionally weigh so much as 10 or 12 lbs.; and one specimen is recorded as being so much as 14 lbs.

The Mullet was believed by the ancients to be the most innocent of fish, and one that did not select as food anything that had life. But the Grey Mullet of Belfast Bay has habits so very much the reverse, that Mr. Thompson remarks, after an examination of the stomachs of many individuals, that they presented "many hundred-fold greater destruction of animal life than he had ever witnessed on a similar inspection of the food of any bird or fish. From a single stomach he had taken as many univalve and bivalve mollusca as would fill a large-sized breakfast cup; so that one of these stomachs may justly be regarded as quite a storehouse to a conchologist." In clear moonlight, and by day, Mullet of every size often clear the net, sometimes springing five or six feet over it, and when one has set the example, nearly all are sure to follow it. Having surmounted the meshy barrier, they sometimes take two or three additional leaps, and skim the surface beautifully, before again subsiding beneath it.

Tenisoniidae. We shall not dwell on the family of the Ribband-shaped fishes, as it contains but about half-a-dozen of native species, and but little is known respecting their habits; we shall merely quote one fact to show how appropriate is

Fig. 206. RED BAJJD-FISH.

their name. A specimen of the Red Band-fish (*Cepola rti-lescens*, Fig. 206), as we are informed by Mr. W. Thompson,

On Fishes new to Ireland *Annals of Natural History*, July, 1838. From this paper the information here given on this Mullet is extracted, f The term denotes like a band or stripe.

was, in November, 1837, when penny postages were unknown, sent to him through the post-office, although nineteen and a half inches long; it was folded up like a ribband, and passed in a franked letter of the ordinary size and legal weight under an ounce. A dead specimen of another was picked up on the beach at Cairn-lough, County Antrim, in 1836, by Dr. J. L. Driunmond, author of *Letters to a Young Naturalist*; and being transmitted to Belfast, was found to be so perfectly unique as to require the establishment of a new genus for its reception. Some of the young for whose use this little book is especially written, may yet, in like manner, be so fortunate as to enrich our Fauna with species of which no other specimens are extant. f

Scomberidæ. The next family contains the Opah, the Dory, and the Sword-fish, all of which have been already mentioned (p. 236, 233). To this belongs the Pilot-fish (*Naucrates ductor*, Fig. 207), celebrated for its attendance

Fig 207. PILOT-FISH.

on the large Sharks, and supposed by the ancients to have pointed out to navigators their desired course, and borne them company during their voyage. Here also must

be placed the Bonito (*Thynnus pelamys*), one of the ruthless pursuers of the Flying-fish; and the Tunny (*Thynnus vul-garis*, Fig. 208), a fish of large size, though here represented by a very diminutive figure. One killed at Inverary Fig. 208. TUNNY.

Magazine of Natural History, 1838.

f It was described and figured by Mr. W. Thompson, in the Transactions of the Zoological Society, vol. ii.; the species being named in honour of the discoverer, *Echiodon Drummondii*.

weighed 460 lbs., and measured seven feet ten inches in length. These fish visit the shores of the Mediterranean in great shoals, and give origin to an extensive and valuable branch of commerce.

Both the species just mentioned swim near the surface, are great consumers of oxygen, and maintain a high temperature. The Tunny is always spoken of by the fishermen of the Mediterranean as warm-blooded; and Dr. Davy mentions, that he has known the temperature of the Bonito to be 99, when the water at the surface of the sea was only 80 °5. We have here, therefore, a curious example of a fish with blood as warm as that of a man.

Highly prized, though of so much smaller dimensions, is the Mackerel (*Scomber scomber* of our own shores. Mr. Yarrell states that the success of this fishery, in 1821, was beyond all precedent. "The value of the catch of sixteen boats from Lowestoffe, on the 30th of June, amounted to, 5,252; and it is supposed that there was no less an amount than 14,000 altogether realised by the owners and men concerned in the fishery of the Suffolk coast." A favourite bait for this fish is a slip of red leather or scarlet cloth; and a scarlet coat has therefore been called a Mackerel bait for a lady.

Sparidce. The Sea Breems (*Pagellus centrodontus*) are furnished with strong jaws, and a great profusion of rounded teeth, by means of which they grind down the shells of the mollusca on which they feed. The Stickle-back (*Gasterosteus*, Fig. 187), and the Gurnard (*Trigla*) exhibit a peculiarity of a different kind. The head appears as if mailed or armed, and hence the term *Loricati*, indicating this peculiarity, is that by which they are distinguished. The species known as the "Fifteen-spined" (ante, p. 230) inhabits the sea, and is apparently fond of coming to the surface in fine weather, for we have taken it in a small towing-net, and on one occasion we saw it captured by a sudden plunge of the hand into the water. The Gurnards emit a peculiar sound when taken from the water; and hence one of them bears the appellation of "the Piper," and another that of the "Cuckoo Gurnard," f

Researches Philosophical and Anatomical.

f The mode in which this is said to be done has been mentioned at p. 219. The "Drum-fish" of the United States is so called from its loud drumming noise. It is sometimes found three feet in length, and 35 lbs. in weight; in calm weather the sound which it emits is heard at a considerable distance.

The *Dactylopterus* of the Mediterranean (*Trigla volitans* Linn. Fig. 209) is a very singular and beautiful species, swimming in shoals, and sometimes rising out of the water in the manner of the Flying-fish, expanding at the same time its pectoral fins, which are large and transparent, of an olive green, with numerous bright blue spots.

Fig. 209. DACTYLOPTERUS.

Percidae. The last family we shall mention is that of the Perch (*Perea fluviatilis*), under which are included the true Mulletts of the Mediterranean; one of these, the striped Red Mullet (*Mullus surmuletus*), is a constant inhabitant of the southern shores of England. So much were they prized by the Romans, that a Mullet of six pounds weight is said to have been sold for a sum equal to 48; one still larger, 64; and even 240 were given for three of very unusual size, procured on the same day, for a repast of more than usual magnificence. The Perch is common throughout all the temperate parts of Europe, and is one of the most beautiful of all our freshwater fishes. The bright vermillion of the tail and lower fins contrasts strikingly with the markings and tints of the other portions of the body. It is a bold and voracious fish. Mr. Jesse tells us that he had placed some Perch in a vivarium (an artificial pond), and in a few days they came freely and took worms from his fingers.

It is interesting, in regarding the class of fishes, to contemplate the variations of structure which connect it with other groups, both of higher and of lower rank in the animal kingdom. We have seen (p. 239) that one small fish the Lancelet has been described as a mollusk. There is another the *Lepidosiren* which has been regarded as a reptile. Perfect unanimity does not prevail among naturalists with regard to its true place, but following Professor Owen, we include it among the fishes. Of this animal two species are at present known one found in the river Gambia, the other in the Amazon. That of the Gambia (*L. annectens*, Fig. 210) inhabits a part of the river which overflows extensive tracts.

Such individuals as do not follow the retreating waters, escape from the scorching rays of the African sun by burrowing in the mud, which is soon baked hard above them. There they remain, in a torpid state, until the return of the rainy season again awakes Fig. 210. *LKPIDOSIREN*. them to activity.

We have endeavoured, with great brevity, to exhibit one class out of the many by which "the world of waters" is peopled. But our knowledge of the recent tribes is imperfect unless we add to it that of the extinct; and, accordingly, the study of the fishes found in a fossil state is a subject of high philosophical research, involving as it does the question not only of what were their forms, but what were the conditions under which they existed. To this inquiry M. Agassiz, of Neuchâtel, has devoted himself; and, in the vast series of investigations which it required, has combined the discriminating eye of the naturalist and the profound generalizations of the philosopher. By him all fossil fishes are arranged in four primary groups, according to the form of their scales; 1st, Ganoid, with scales shining, as the Sturgeon. 2d, Placoid, with scales broad-plated, as Sharks and Rays. 3d, Ctenoid, with scales comb-shaped, as the Perch. 4th, Cycloid, with scales of circular or smooth edges, as the Cod and Herring, f

The researches of Agassiz have led him to infer, that there

For details connected with its organization, vide Professor Owen's Lectures, and Memoir in Trans. of Linn. Society, vol. xviii., part iii. It is regarded by him as the representative of a distinct order Protopteri occupying a position between the one containing the Sturgeon and that with the Sharks and Rays.

f These terms are all derived from the Greek; the literal meanings being nearly those which are here given.

is a constant correspondence between the characters of the scales and the internal organization of the fish.

When the number of fishes now living and possessing scales of these different forms, is compared with the number of those which formerly existed, we find that species and genera, which in countless multitudes swam in the ocean which then covered our existing continents, have long since passed away. Those whose vestments of enamel have bid defiance to the hand of Time, exhibit, sculptured on their scales, ornaments of microscopic beauty and diversified pattern. As an example of the singular forms presented by some of these fossils, we shall quote one brief paragraph, descriptive of some of the fossil fishes of the Old Red Sandstone.

"A stranger assemblage of-forms has rarely been grouped together; creatures whose very type is lost fantastic and uncouth, and which puzzle the naturalist to assign them even their class;-boat-like animals, furnished with oars and a rudder; fish plated over like the Tortoise, above and below, with a strong armour of bone, and furnished with but one rudder-like fin; other fish, less equivocal in their form, but with the membranes of their fins thickly covered with scales; creatures bristling over with thorns; others glistening in an enamelled coat, as if beautifully japanned the tail, in every instance among the less equivocal shapes formed, not equally as it is in existing fish, on each side the central vertebral bone, but chiefly on the lower side, the bone sending out its diminished vertebrae to the extreme termination of the fin. All the forms testify of a remote antiquity of a period whose 4 fashions have passed away." The figures on a Chinese vase or an Egyptian obelisk are scarcely more unlike what now exist in nature than the fossils of the Lower Old Red Sandstone."

NOTE. ON THE IMPROVEMENT OF FISHERIES, AND THE EDUCATION OF FISHERMEN. In an economical point of view, Zoology could not be turned to better account than in the right direction and promotion of the

From a delightful and highly-instructive volume entitled, "The Old Red Sandstone, or New Walks in an Old Field," by Hugh Miller. The first chapter tells us that the author was himself a working man, and describes " the quarry in which he wrought." It was while labouring in that humble vocation that his attention was first roused to the fossils of the " Old Red Sandstone;" a formation with which his name is now indis-solubly connected.

fisheries. This was forcibly put forward by Mr. R. Ball, in 1839, in a lecture delivered before the Royal Zoological Society of Ireland, in which he showed how much science might be made to conduce to the welfare of fishermen, by affording them information on the nature and habits of fish, their migration, and food, viewed in connection with the geological character of the coast. He at the same time proposed a plan for imparting to them scientific and practical instruction by means of nomadic or wandering schools.

Subsequently the application of science to our fisheries has been ably urged, both in London and Dublin, by that eminent naturalist, Professor Edward Forbes. He has shown that the North Atlantic Ocean may be divided into certain zoological provinces; that each province owes its characteristic features to geological changes which occurred in a certain order; and that "the dispositions of the great sea-fisheries of Europe depend upon the disposition of the existing zoological provinces of the

European seas." To the last point the learned lecturer called particular attention, and strongly advocated scientific inquiry properly directed, and the training and instruction of fishermen, as suggested by Mr. Ball.

The great importance of this subject in its bearing upon the British fisheries, and more especially upon those of Ireland, gives additional interest to the following extract from the Thirteenth Report of the Commissioners of National Education in Ireland.

"VII. 33. The same practical character which we are anxious to give to our country schools, by the mixture of agricultural with literary instruction, we shall endeavour to give to such of our own schools as are situated on the coast, by uniting instruction more peculiarly applicable to maritime districts, with the ordinary school education. With the view of promoting this object, and of testing its practicability, we have made a larger grant towards the establishment of a school in the town of Galway, at the fishing station called the Claddagh. In this school it is proposed that the pupils shall devote a portion of their time to acquiring a knowledge of navigation and of the art of fishing, and shall be employed in manufacturing nets and the various other articles required by fishermen in their trade."

Saunders's News-Letter, 24th May, 1839.

t At the Royal Institution, 14th May; see Athenaeum, 22d May, 1847.

t Before Zoological Society of Ireland, Saunders's News-Letter, 29th May, 1847.

THE Class Reptilia constitutes another of the great groups of vertebrated animals. Respiration is effected in some of the Reptiles by lungs and gills; in others, by lungs only. The blood is cold. The heart consists of three cavities. The young are produced from eggs.

The great majority of these creatures are regarded by man with suspicion and distrust; yet there is no class of vertebrated animals which presents the same variety of form and structure. Among quadrupeds, the tiny Field-mouse (*Mus messorius*) that suspends her nest from a blade of corn, resembles, in all essential points of structure, the ponderous elephant. Among birds, in like manner, the diminutive Wren claims a place in the same phalanx with the majestic Condor of the Andes. But who, except the naturalist, could venture to affirm that the flexile Snake should be class-fellow to the Shell-covered Tortoise?

Reptiles are most numerous in the countries of the torrid zone, a few only being found in those of more temperate regions. It has been well remarked, that "they can more easily bear the rigours of a severe winter than suffer the absence of a hot summer." The number of living species which is known and described amounts to six hundred and fifty-seven. They are divided by Cuvier into four orders; and, although some changes have been proposed by naturalists whose opinions are entitled to great respect, it will better suit the simplicity which is desirable in an elementary work, to adhere to the former arrangement, and treat of them as Tortoises, Lizards, Serpents, and Frogs.

The number of species belonging to each of these orders is very different, and may be thus stated:

Tortoises (*Testudinata*) 69

Lizards (*Lacerta*) 203

Serpents (*Ophidia*) 265

Frogs Amphibia) 120 It is interesting to remark the manner in which, according to Berghaiis, the number of species diminishes as we pass from the sunny regions of the East to the duller and more cloudy climes of Western Europe. Thus Italy with her islands can number forty-seven species; France has thirty-one; Great Britain, fourteen; and Ireland, it may be added, not more than five.

It has been stated that the blood of reptiles is cold; or, in other words, their power of producing animal heat is so feeble that we do not notice any difference between the temperature of their bodies and that of the air or water by which they are surrounded. The same was observed in the preceding group of cold-blooded vertebrata the fishes but arose from a different cause. In the fishes the blood is imperfectly aerated, owing to the small quantity of oxygen with which it comes in contact in the gills. In the highest of the reptile tribes, which breathe exclusively by lungs, these organs are supplied with only a portion of the blood that has circulated through the veins; the other portion is returned into the circulation without being purified by exposure to the air. The arteries consequently contain a mixture of blood rendered impure by its previous circulation, and blood recently aerated

Berghaiis and Johnston's Physical Atlas, from which admirable work all the information here given, as to the distribution and number of species, is derived.

Of Namely, two Turtles, two Lizards, one Blind-worm, two Snakes, two Frogs, two Toads, and three Newts, In a Memoir read before the Royal Society, by Mr. Higginbottom, entitled, "Researches to determine the number of species and the mode of development of the British Triton, the author states, that only two species of Tritons or Newts are met with in England, and that the animals require four years to attain their full growth. "The Triton," he remarks, "possesses the power of reproducing its lost limbs, provided the temperature be within the limits of 58 and 75 Fahrenheit; but at lower temperatures, and during the winter, it has no such power." Athenaeum, April 3, 1847; Annals of Natural History, July, 1847.

in the lungs. "Hence" says Professor Bell, "arises the circumstance that these animals have what is called cold Wood; for, as it is from respiration that the blood derives its heat and the temperature of the body is thereby sustained, in animals which have more perfect respiration, it follows that where this function is but imperfectly performed, the animal heat, muscular force, and all other functions dependent on respiration, will be diminished."

In the last class to which our attention was directed that of fishes the circulation throughout life was suited to their residence in water. The first we shall notice in the present class are likewise fitted for aquatic respiration. We shall next proceed to those which in their very early stages breathe by gills, but afterwards by lungs; and thence pass on to those which at all periods possess aerial respiration.

ORDER I. AMPHIBIA.

"The swimming Frog, the Toad, the Tadpole, the Wall-Newt, and the water." SHAKSPEARE.

THE Amphibious Reptiles (order Batrachia of Cuvier) may be separated into two divisions those which possess both lungs and gills throughout the entire period of life, and those which have gills in their young state, and acquire lungs as they approach

maturity. J The former group possesses some animals of very singular structure and habits; as the *Proteus*, which inhabits subterranean lakes in the Tyrol, the *Axolotl*

History of British Reptiles Yan Voorst. Another of that attractive series of works illustrative of the natural history of these countries. In the opinion of the learned author of that work, the structural peculiarities of the Amphibia are such as to justify their being regarded as a distinct class, instead of being merely ranked as one of the orders in Fishes the class Reptilia. Mr. Jennings has thus arranged them in his "Manual."

f From the Greek word signifying a frog (Lat. *Bdtrachus*). The term Batrachian means, therefore, a frog-like animal.

J Those in which the gills are permanent are termed PEREXNIBRAN-CHIATE (Latin, bronchia, the gills, and perennis, permanent, lasting, staying all the year round). Those in which the branchiae disappear, are termed CADUCIBRANCHIATE, the word caducus meaning perishable, falling of itself, c.

(Fig. 211), the flesh of which is regarded as an article of luxury by the inhabitants of the city of Mexico, near to which it is taken. It is, however, to the latter group that we wish more particularly to call attention; for in the Frogs, Toads, and Newts of these countries, we have the opportunity of watching the successive steps by which they become fitted for breathing air, instead of continuing to use an apparatus adapted, like that of fishes, for aquatic respiration only.

Fig. 211. AXOLOTL.

Let us give our attention, in the first instance, to the changes which take place in the common Frog (*Rana tempo-raria*). The eggs are deposited at the bottom of a pool of water, each egg consisting of a black centre, surrounded by a covering of glutinous matter. This covering absorbs water; the mass swells, so that the central portions appear like black dots, separated from each other by a transparent jelly; and owing, as Professor Bell states, to some partial decomposition, and the consequent disengagement of a gas, the entire mass becomes lighter than the surrounding water, and rises to the surface. It is in this stage that we have taken some of the spawn, and kept it in glass vessels for the purpose of watching the subsequent changes, which are much influenced by the temperature of the apartment. When the little Tadpole has burst from its prison, the gills begin to develop themselves, and increase rapidly in size until they attain their greatest development. They are now objects of singular beauty when viewed through the microscope; for such is their transparency that the course of every globule, as it passes up or down the main stem, or enters the inlets presented by each leaf, is distinctly visible. The delight with which this spectacle is regarded by children, and the interest they henceforward take in the previously despised Tadpole, are matters of which we can speak from personal experience. This period of expansion is, however, more temporary than that of many of our cherished garden flowers. The tufted gills shrink in size, until, like the gills of fishes, they are concealed within the branchial sacs. The little Tadpole (Fig. 212) begins to feed on decaying vegetable matter; the tail has become a large and powerful organ for locomotion, and a rapid increase in the size of the body is perceptible. After a time the hinder feet become developed (Fig. 213); then the anterior extremities bud forth. (Fig. 214); the tail shrinks; the form of the perfect animal is assumed (Fig. 215); the remaining vestige of the tail disappears (Fig. 216); and instead of an aquatic animal

breathing by gills, and subsisting on vegetables, we have a terrestrial animal, breathing by lungs and altogether carnivorous.

Fig. 212.

Fig. 213.

Fig. 215.

Fig. 2 1C.

The food of the Frog consists of insects of various kinds, and of small Slugs; the number which is thus destroyed is so considerable, that the Frog might prove a valuable assistant to the farmer or the gardener. The manner in which the food is taken is worthy of notice. In the Frogs, as in the Toad, the tongue is doubled back on itself. The point, covered with a viscid secretion, is thrown forwards upon the insect and drawn back again with such rapidity as scarcely to be detected without careful watching.

In some of the countries of both temperate and tropical regions there are Frogs which, from their habitation, are called

We are informed by a friend, who has watched the metamorphosis with great attention, that the left fore leg is perfectly developed before the other appears.

t Bell's Reptiles.

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Fig. 217 TREE-FROG.

270 INTRODUCTION TO ZOOLOGY.

Tree-frogs (Hylce, Fig. 217). They are described as beautiful and active little animals, not unlike in their colours to those of the trunks and foliage, and furnished at the end of their toes with small cushions or pads, by means of which they can adhere to smooth surfaces. Some of them utter a pleasing chirp, which in the cool evenings swells into a kind of concert, the Cicadas and Crickets taking part in the performance.

The respiration of the Frog is not carried on by the lungs alone, but also by the skin; and in order that the skin may be always kept moist, and in a state fit to perform this important function, the creature is furnished with an internal reservoir of pure water, absorbed and there deposited when fluid is abundant, and given back to the skin when additional moisture is required. There is a peculiarity even in the pulmonary respiration: it cannot be carried on in the Frog by the expansion and contraction of the chest, for it is destitute of ribs. The air is taken into the mouth, and the nostrils and throat being closed, it is forced down into the lungs. As this movement can only be performed when the mouth is shut, the poor creature would perish for want of pulmonary respiration if gagged with the mouth open. f

The Frog is believed to have been introduced into Ireland in the early part of the last century. The common Toad (*Bufo vulgaris*) is there unknown, its absence being accounted for, according to popular tradition and song, by the malediction of St. Patrick. The smaller species, the Natter-jack (*B. ca-lamita*), does not appear, however, to have been banished with the rest of ' ' the varmint, ' ' as it is found in three or four localities in the County Kerry, and at Ross Bay, County Cork. Both Frogs and Toads pass the winter in a state of torpidity.

At Rio de Janeiro. Darwin's Journal, p. 34.

f Bell. Berghaiis and Johnston mention that the common Frog (*Rana temper arid*) is found on the Pyrenees at an elevation of 7,700 feet.

The remainder of the British Amphibia belongs to the family Salamandridse, and consists of four species of Newts, of which one only (*Lissotriton punctatus*) appears to be generally distributed in Ireland. In the northern parts it is well known by the name of ' Mankeeper,'" and is regarded by the uneducated with apprehension, from the erroneous idea that it is prone to jump down the throat of any one whom it may find sleeping.

The metamorphosis of the Newts is so similar to that of the Frogs, that any detail on the subject is unnecessary. The leaf-like tufts that float in the water (Fig. 218) are different in form, though alike in function. But it is not only in external figure that the changes of the amphibia are remarkable; those in internal structure are to the physiologist even more interesting. The important function of circulation must of course be adapted to that of respiration. Each change in the one necessarily involves a corresponding modification of the other. It is not our intention to go into any minute anatomical details; we would only refer to the accompanying figures, to show the nature and extent of these internal changes. In the first (Fig. 219) the blood-vessels of Fig. 219.

the Tadpole are shown in an early stage; the second (Fig. 220) in a more advanced state, and with those arteries which are to convey the blood to the lungs greatly increased in size.

Fig. 220.

In the third (Fig. 221) the gills have disappeared, and the respiratory circulation is carried on by the arteries of which the development was exhibited in the previous figure.

The Newts, like the Frogs and Toads, are carnivorous, preying upon aquatic insects, larvse, worms, and mollusca; nor do the larger species hesitate at laying hold of and devouring their weaker and smaller brethren. The Tadpole of the Frog forms also an important item in their bill of fare.

When it is considered that all the amphibia are harmless to man, and many of them actually useful, by keeping in bounds the diminutive assailants of his crops and pastures, it may seem strange that they should have been so generally regarded as disgusting and pernicious. Perhaps no individual among them has been so slandered as the Toad; and if we did not know, in other instances, how imagination takes the place of reason, it might seem incredible that this unoffending reptile should have been regarded as " highly poisonous, and this not only from its bite its breath and even its glance were fraught with mischief or death." It was natural, therefore, that

Bell's Reptiles.

Fig. 221.

Shakspeare, living at a time when such ideas were still current, should embody them in his writings, and speak of the Toad as " loathsome," " venomous," and " poisonous;" should place it first in the cauldron of the witches, and add thereto,

"Eye of newt and toe of frog."f

Such records, " figuring the nature of the time deceased," are of high interest and value, for they serve most impressively to mark the varying phases of popular belief

at different epochs. In one passage the poet has given us a singular though erroneous tradition, and a profound moral truth- f Sweet are the uses of adversity, Which, like the toad, ugly and venomous, Wears yet a precious jewel in his head."

As You LIKE IT, Act ii. scene 3.

There is evidence of the former existence in these countries of a gigantic reptile of the present order. From the peculiarly convoluted structure of its teeth it has received from Professor Owen the highly descriptive appellation of *Lahyrinthodon*: a term compounded of two Greek words, signifying "a labyrinth" and "a tooth." It has left the mark of its footsteps, resembling the impression of a hand, on the moist sand-beach of the ancient seas, which sand is now consolidated into what is termed "new red sandstone." The impressions vary in size; but those of the hind feet are invariably much larger than those of the fore. In some cases their length is so much as twelve inches, while that of the smaller is about four inches. At the Storeton hill, near Liverpool, on the west side of the Mersey, similar marks have been found, along with those left by five or six smaller reptiles.

"As loathsome as a toad." TIT. AND. Act. iv. scene 2.

"As venom'd toads." Third Part K. HENRY VI. Act ii. scene 2. "This poisonous hunch-backed toad." RICHARD III. Act i. scene 3. f For convenience of reference, the passages referred to are extracted: First Witch "Toad, that under the cold stone

Days and nights hast thirty-one,

Swelter'd venom sleeping got,

Boil thou first i' the charmed pot! Second Witch Fillet of a fenny snake, In the cauldron boil and bake:

Eye of newt and toe of frog,

Wool of bat and tongue of dog,

Adder's fork and blind-worm's sting,

Lizard's leg and owlet's wing."

MACBETH, Act iv. scene 1.

Fig. 222. ANATOMY OF A SNAKE.

THE internal structure of one of the Serpents is represented in the preceding figure (Fig. 222). We shall only add, that in order to endow these tribes with the greatest possible flexibility, the number of joints in their spinal column is even greater than in the Eels. In the Rattle-snake (*Crotalus*, Fig. 223) there are about two hundred; and above three hundred have been counted in the spine of the Viper (*Natrix* tor quota). Thus furnished, they can glide along with silence and rapidity, climb trees, and leap with considerable vigour and agility.

The number of Serpents, like that of other reptiles increases towards the torrid zone, while comparatively few are found in cold regions. They do not appear to advance so far northwards as Frogs and Lizards.

"One of the most curious facts in the distribution of Serpents, viewed in relation to different parts of the globe, is their total absence from the numerous isles of the Pacific Ocean a phenomenon the more remarkable, since the neighbouring isles forming the great Indian Archipelago belong to those regions of the earth most abounding in Serpents. Another interesting fact is, that the Serpents, and indeed all the reptiles of America, are specifically different from those of the Old World; while, on the other

hand, a great many birds and several mammiferous animals of North America are precisely the same as those of Europe and a great part of Asia."t

Some Serpents live amid the foliage of trees, some inhabit fresh waters, some poisonous tribes live in the seas of tropical Asia and New Holland, but by far the greater number are terrestrial. According to Schlegel, there are at present 265 known species, and of these only 58 are venomous; so that the proportion of the harmless ophidians to those which are

Koget's Bridgewater Treatise, vol. i. p. 450.

f Schlegel, "Essai sur la Distribution Geographique des Ophiidiens," as abridged in Berghaiis, Physical Atlas.

Fig. 223. RATTLE-SNAKE.

venomous is nearly as four to one. This is contrary to popular opinion, and it was especially so in the "olden time." Thus, whenever Shakspeare mentions one of those animals, it is always as a creature to be shunned as hateful or venomous:

"He is a very serpent in my way; And wheresoe'er this foot of mine doth tread, He lies before me." KING JOHN, Act iii. scene 3.

The gigantic Boa-Constrictor "belongs to those which are not venomous. It kills its prey by the enormous compression it exerts when coiled round the body of its victim, which it then proceeds to swallow entire. The teeth are sharp, point backwards, and thus retain the food. And here comes into use a curious and bountiful provision with which snakes are furnished. The lower jaw is not united to the upper; it is hung to a long, stalk-shaped bone, upon which it is moveable (Fig. 224); and this bone has also a power of motion, being attached to the skull by muscles and ligaments. By means of this apparatus, which is common to all true Serpents, they can swallow animals larger than themselves. This being done, they remain in a quiescent state until digestion is completed, and the calls of hunger again excite them to exertion.

In addition to this elaborate contrivance, the venomous tribes are furnished with poison-fangs, 'constituting perhaps the most terrible weapons of attack met with in the animal creation'! (Fig. 225). They are two in number, fixed to the upper jaw, or, to use more precise language, one

Fig. 225. p, poison gland; its duct terminates in the large moveable tooth or fangym, muscles which raise the lower jaw and compress the poison gland.

Fig. 224. SKULL OF RATTLE-SNAKE.

Fig. 225. POISON APPARATUS OF RATTLE-SNAKE.

f Jones's Outline of the Animal Kingdom.

is fixed to each superior maxillary bone. When not in use, they lie flat upon the roof of the mouth, concealed by a fold of the skin. In each fang is a channel, which opens, not at the point of the tooth, but near to it, by a longitudinal fissure. Through this passage the poison flows. When the animal is irritated the poison-fangs are erected in a moment; and when they are struck into the victim, it is easy to imagine how forcibly the poison must be injected into the wound; for the powerful muscles which elevate the lower jaw serve at the same time to compress the poison-bag.

Behind the large poison-fang in actual use are the germs of several others, ready to supply its place if accidentally broken off, each of which is soon "adapted in all respects to take upon itself the terrible office of its predecessor."

The poison itself is neither acrid nor burning. On the tongue it only produces a sensation like that of fatty matter, and it may be swallowed without danger; but introduced into the blood in sufficient quantity, it causes death with fearful rapidity, though the power varies, according to the species and other circumstances. To avoid such consequences, the best precaution is that which is adopted in these countries for the bite of a dog supposed to be mad: the immediate cutting out and cauterising of the wounded part.

In one genus of the poisonous Serpents there exists a provision which puts the unwary on his guard, and discloses the proximity of the dangerous reptile. We allude of course to the Rattle-snake (Fig. 223). Its tail is terminated by a series of horny rings, loosely put together, which rattle with the slightest movement of the animal, and even with the vibrations of the tail when the creature itself lies in concealment.

Among the venomous Serpents is one which possesses a classical and historical interest, associated as it is with the death of Cleopatra the Egyptian Naja or Asp (Fig. 226). It is at present much used by the Egyptian jugglers in their exhibitions. One of a nearly allied species, the Cobra-di-Capello, has a curious mark on the skin of the neck, not unlike a pair of spectacles. A specimen of this Snake was presented to the Belfast Museum, by Major Martin (now residing

The information here given respecting the poisonous Serpents is almost entirely derived from Jones's Outline, Carpenter's Zoology, and Milne Edwards's " *Eléments de Zoologie*."

at Arclrossan, Ayrshire), who narrated to us the following interesting occurrence: While stationed in Ceylon, his servant one morning ran into his room, and informed him that a favourite Hen was lying dead in her nest, and that the twelve eggs on which she had been sitting were taken away. Supposing it must have been by a Snake, immediate search was made throughout the hen-house and other adjoining premises, when a Cobra-di-Capello was found under a piece of wood, and was immediately killed; being opened, the eggs were found in its belly. Nine out of the twelve eggs were broken; the remaining three were immediately put under another Hen that was sitting, and in due time a chick was produced, and the race of the feathered favourite thus preserved from extinction.

Some of the great Snakes found in India incubate, or sit on their eggs. This fact was observed in the case of a female (*Python liviuatus*) in the menagerie of the Museum at Paris. Her body was coiled round the eggs (fifteen in number) forming a cone, at the top of which was her head. The temperature of the body was sensibly augmented while incubation was going on, which lasted for nearly two months. During the whole of this period she ate nothing, but drank greedily the young were hatched she left them to themselves, evincing no further affection for the offspring over which she had so sedulously brooded.

The remains of Serpents of this tribe, and of that of the Boa-Constrictor, have been found in the London clay, thus proving the former existence in these kingdoms of reptiles which are now only known in tropical countries. No Snakes

Armales des Sciences Naturelles, tome xvi., p. 65. Quoted in Note to Jenyns's Edition of White's Selborne, p. 69.

of any kind whatever exist in Ireland. In England, the harmless tribes are represented by the Common or Ringed Snake (*Natrix torquata*), and the venomous by the Adder, or Common Viper (*Peliuss berus*). The injurious results of the bite of the latter reptile would appear to be much exaggerated. Professor Bell states that he has never seen a case which terminated in death, nor has he been able to trace to an authentic source the numerous reports of such a termination.

Both species lie torpid during the winter, concealed under hedges, or the hollow roots of a tree, or any other sequestered and sheltered situation. The numbers that thus remain coiled together are sometimes so considerable, that Dr. Carpenter mentions an instance which came within his own knowledge, of 1,300 Ringed Snakes being found in an old limekiln. The return of a more genial season and a higher temperature again rouses them to activity. Hence the remark of the poet

"It is the bright day that brings forth the adder, And that craves wary walking."
SHAKESPEARE.

These reptiles possess, as is well known, the power of changing or casting off their skin. Before it is cast off a process which appears to take place at uncertain intervals the colouring is dull, and the animal seems blind. When the new skin is completely formed and hardened underneath, the old one bursts or splits asunder about the neck, being removed as the animal passes through any tangled copse.

A remarkable difference exists between the Common Snake and the Viper with regard to the production of their young. The former is oviparous, and deposits from sixteen to twenty eggs, which are vivified by heat. The latter is ovo-viviparous; that is to say, the young are produced from eggs; but in the very act of deposition the membranous covering of the egg is rent asunder, and the young which vary in number from sixteen to twenty come forth alive.

Dr. Clarke, in speaking of the Common Snake, remarks "The movements of this species are highly elegant. Its course among grass or underwood is performed in a zigzag direction; the head and neck are thrust forward alternately to the right and left, whilst the rest of the body follows precisely the same course. In its progress the head pushes aside the blades of grass or other yielding bodies, and the remainder of

Zoology, vol. i. p. 569.

the body follows without communicating any motion to them; and in this way a snake will often steal across a meadow, or through a thicket, unperceived by a person standing at a little distance." In contrast with the clear and simple statement here given of the movements of the common English Snake, it is interesting to place the magnificent description so well known to every reader of "Paradise Lost":

"So spake the enemy of mankind, enclosed In serpent, inmate bad! and toward Eve Addressed his way; not with indented wave Prone on the ground as since, but on his rear Circular base of rising folds, that tower'd Fold above fold, a surging maze! his head Crested aloft, and carbuncle his eyes, With burnished neck of verdant gold, erect Amidst his circling spires that on the grass Floated redundant." BOOK ix.

Like many other now exploded specifics, the flesh of Serpents, or the liquid, especially wine, in which they were infused, was held of peculiar efficacy for the cure of disease, and as an antidote to poison. These ideas, preposterous as they may now appear, were not discarded until the last century was far advanced. In Dr. Owen's work

on Serpents, published in London in 1672, we are informed that " their flesh, either roasted or boiled, the physicians unanimously prescribe as an excellent restorative, particularly in consumptions and leprosy."

There is another reptile equally inoffensive, and not less maligned than some already mentioned the Blind-worm, or Slow-worm of Britain, described as the "eyeless venom'd worm" by Shakspeare. Yet it has in fact no poison fangs, and is naturally of so timid and gentle a disposition, that only under circumstances of great provocation will it attempt to bite. It is unknown in Ireland; but in Scotland we have seen it broken in two by the blow of a slight rod, thus illustrating the correctness of the Linnsoan appellation *Anguis fragilis* the Fragile Snake.

To the systematic naturalist this creature is interesting from its exhibiting in certain points the characters of two distinct classes of reptiles. The body is destitute of legs, in that respect resembling the true Serpents, while at the same time

Magazine of Natural History, 1838, p. 479.

the jaws and cranium are consolidated, thus resembling those of the Lizards.

The great altitude at which some Snakes are found is worthy of notice, as it necessarily involves their capability of living at a lower temperature than might have been expected. It is stated that two species of Viper, one of them the Common Adder of England, are found on the Alps at an elevation of 5,300 feet; and the Blind-worm nearly as high as 6,000 feet.

ORDER III. SAURIA. LIZARDS.

' Gay Lizards glittering on the walls Of rained shrines, busy and bright, As they were all alive with light." MOORE.

IN this order the body and tail are elongated, the jaws are furnished with teeth, the skin is covered with scales, and the animals have generally four feet. About two hundred species are known, which are distributed by naturalists into nine or ten families, and numerous genera.

The flesh of many of the foreign Lizards, when cooked, is white, and is relished as very good food. Humboldt has remarked that all the South American species within the tropics, and inhabiting dry regions, are esteemed delicacies for the table. Their habits present considerable variety. Mr. Darwin mentions one (*Amblyrliyncus cristatus*) that swims out to sea at the Gallipagos Islands, and feeds upon a sea-weed that grows at the bottom; and another (*A. sub-cristatus*) that makes burrows on the land. He watched one of these for along time while making its excavation. "I then," continues he, " walked up and pulled it by the tail; at this it was greatly astonished, and soon shuffled up to see what was the matter, and then stared me in the face, as much as to say, What made you pull my tail?" '

The genus which comprises the greatest number of species is that of the Iguanas (Fig. 227), which are found only in

Fig. 227. IGUANA.

the New World. Some of these are so much as five feet in length, and the colour a beautiful green of a variety of shades. They have a singular crest along the back, and a hanging pouch, like the dewlap of oxen, under the chin. This pouch they have the power of inflating with air. They live among the branches of trees, and feed principally,

but not exclusively, upon leaves and fruits. Eggs and insects form a portion of their diet.

Darker in colour and more repulsive in aspect are the

Fig. 228. GKCKO.

Geckos (Fig. 228) or Nocturnal Lizards. " Though timid and harmless, they are always regarded by the vulgar as

A gigantic fossil reptile discovered in the South of England, in 1834, by Dr. Mantell, is named the Iguanodon, from its resemblance in many points of structure to the Iguana.

venomous and highly dangerous. Besides the depressed form of the body, they are eminently distinguished by having the feet palmated, or rather lobed and dilated into discs." In consequence of this peculiarity of structure they can ascend walls, and even run along ceilings. They lurk in crevices during the day, and come forth at night in pursuit of their insect food.

Perhaps, however, there are no reptiles to which a greater degree of popular interest attaches than to the Cameleons (Fig. 229). They are exclusively natives of the warm parts

Fig. 229. CHAMELEON.

of the Old World, and exhibit several structural peculiarities. Like other Lizards they have five toes; but they are divided into two parcels, and thus adapted for climbing. The tail also serves as an instrument for prehension. The eyes have such independent powers of motion that they can be turned in the most opposite directions at the same time. The tongue is of great length, and is terminated by an adhesive disc, which they dart out with unerring aim at their insect prey. We have watched for hours their sluggish and almost inanimate appearance, though even at such times they occasionally manifest the singular changes of colour for which they are so celebrated. These, however, are not to the extent set forth in a well-known poetical composition, with which every school-boy is familiar; but after all allowance for poetical exaggeration, the phenomenon is sufficiently curious to have been for a long time one that naturalists were unable to explain. It was reserved for Milne Edwards to solve the problem. He has shown that there exist, in the skin of

Swainson on Fishes, Amphibia, and Reptiles, f Annales des Sciences Naturelles. January, 1834.

these animals, two layers of membraneous pigment, or colouring matter, so arranged that both may be visible at the same time; or that the lower layer may appear in varying proportions amid the upper; or that it maybe altogether concealed beneath it. This mechanism is similar to that which exists in some of the Cuttle-fish, to whose changes of colour we have already referred (Part I., p. 190).

The Lizards, which are regarded as the true types or representatives of the order, do not belong to any of the families yet mentioned, but to the Lacertidæ. These have long, slender, forked tongues, and are the attractive and nimble reptiles which greet the eye of the traveller in France and Italy. The family is not confined to Europe, some of its members are found in each of the four quarters of the globe. It is to this group that the two species of English Lizard belong *Lacerta agilis* and *Zootica vivipara*. Between them a difference exists similar to that which has been mentioned in the two

species of Snakes (p. 279). The larger Lizard (*L. agilis*) is oviparous; the smaller (*Z. vivipara*) brings forth her young alive: or, to speak more correctly, is ovo-viviparous.

Perhaps no one circumstance connected with their economy is more surprising, when seen for the first time, than the facility with which the tail separates from the body. Great is the astonishment of a person unacquainted with this peculiarity, when he grasps the tail and finds it remaining in his hand, while the swift-running reptile effects its escape.

The following characteristic occurrence is narrated by Dr. J. L. Drummond: "Being on the sea-shore at Pulo Bay, in Sardinia, and searching for specimens of natural history, I observed a large Lizard running for shelter under a heap of stones. I was just in time to seize it by the end of the tail; but suddenly the resistance made by the animal to my attempt to drag it from its hiding place ceased, and I gave it up for lost; but as suddenly had cause for alarm myself, on seeing what appeared to be a small Snake leaping with great agility about my feet, and springing as high as my knee. I instantly started out of its way, and watched it at a respectful distance, when I found that it was the tail of the animal, which I was not before aware could so easily separate."!

The meaning of this term has been already explained, vide p. 279. f "First steps to Anatomy," p. 86,

As these animals come forth in sunny weather, decked in bright colours, and gifted with the power of rapid movement, it is not strange that, in more southern countries, where they are more numerous than here, they should be mentioned among the peculiarities and attractions of the scenery.

'The green hills

Are clothed with early blossoms, through the grass The quick-eyed lizard rustles, and the bills Of summer-birds sing welcome as ye pass."

CHILD HAROLD, canto iv. st. cxvii.

From the most popular of the order, we turn to the most formidable, the Crocodiles. Of these, "the Alligators or Caymans are peculiar to America, the true Crocodiles to Africa, and the Gavials to Asia. " The Crocodile of the Nile formed one of the innumerable idols of the ancient Egyptians. His great strength is almost proverbial. "He esteemeth iron as straw, and brass as rotten wood. The arrow cannot make him flee; sling-stones are turned with him into stubble. Darts are counted as stubble; he laugheth at the shaking of a spear. "J Yet this formidable reptile is endued with habits which render him one of the great benefactors of the human race.

"In the grand policy of nature, the scavengers are by no means the least important agents. In hot climates especially, where putrefaction advances with so much rapidity, were there not efficient and active officers continually employed in speedily removing all dead carcasses and carrion, the air would be perpetually contaminated with pestilential effluvia, and entire regions rendered uninhabitable by the accumulation of putrefying flesh. Perhaps, however, no localities could be pointed out more obnoxious to such a frightful cause of pestilence than the banks of tropical rivers those gigantic streams which, pouring their waters from realm to realm, daily roll down towards the sea the bloated remains of thousands of creatures which taint the atmosphere by their decomposition."

Such are precisely the situations inhabited by the various species of Crocodiles and Alligators. They are specially

Berghaii's Physical Atlas. By several naturalists the Crocodiles are formed into a distinct order, termed, from their peculiar covering, Loricata, or mailed.

t Job xli. 27 29.

j Jones's Outline, 559.

designed by nature to feed upon putrefying materials, and so strong is this impulse, that when they drown a living animal, it is said not to be devoured immediately, but dragged into some place where it can be kept until decay has set in.

But though, like other gourmands, the Crocodile keeps his game until it has acquired the racy flavour and tenderness of muscle which comes with decay, the organ of taste, the tongue, has not the usual freedom of motion; it is flat and fleshy, and is attached to the mouth so much that the ancients supposed it was altogether wanting.

We can account, therefore, for their idea respecting the tongue, but there were other notions current respecting these reptiles which cannot be so easily explained; such as their uttering piteous cries to allure travellers to the water, and there destroying them, weeping while they did so. To this tradition Shakspeare alludes in the passage ' Gloster's show I Seguilles him, as the mournful Crocodile With sorrow snares relenting passengers."

Second Part KING HENRY VI. act iii. scene 1.

In the " Voiage and Travaile of Sir John Maundeville, Knt," between the years 1322 and 1356, we are furnished with another example of the prevalence of these old errors:

"In that contre and be all yonde, ben great plenty of Crokodilles, that is a manner of a long Serpent, as I have seyde before. These Serpents slew men, and thei eaten hem wepyng; and whan thei eaten, thei meven the over jowe, and nought the nether jowe: and thei have no tonge."

The Crocodile sometimes attains the length of thirty feet, but Mr. Swainson remarks, "that it is only dangerous when in the water; upon land it is a slow-paced and even timid animal, so that an active boy, armed with a small hatchet, might easily despatch one' He elsewhere adds, that on land, " so far from attacking man, they fly from his presence."

The beneficent provision by which the teeth are kept at all times in full order for their appointed functions, is not less complete or effectual than in the Shark (p. 242) or the Serpent (p. 277): a successive series of new teeth is ever growing throughout the entire period of life; each grows through the central portion of its predecessor, which is partly

Swainson.

absorbed and finally thrown off. It was supposed by one writer that the Crocodile had so many teeth as there are days in the year. Professor Owen remarks that the number of teeth developed by a Crocodile, throughout its entire life, would doubtless exceed even this liberal allowance. But with regard to those which are in use at any given time, the number is now well ascertained: the Crocodile of the Nile has sixty-eight; the common Alligator (A. Indus, seventy-six; and the great Gavial (Gavialis Gangeticus), one hundred and eighteen.

This notice of saurian reptiles, however light, cannot be closed without some reference to the strange forms and gigantic proportions of the fossil species discovered in these countries.

Fig. 230. **ICHTHYOSAURUS.**

One of them, the *Ichthyosaurus* (Fig. 230), or Fish-lizard, received that name from some resemblance of the vertebrae to those of fishes. Seven or eight species are now known, exhibiting singular combinations of structure, such as are no longer found united in any living animal. Some of these individuals were not less than thirty feet in length. They were marine reptiles, preying upon fishes whose scales and bones, found in hardened masses in the interior of the skeletons and strewn elsewhere in great abundance, unfold a tale respecting the former inhabitants of the ancient ocean from which these islands were upheaved.

Fig. 231. **PLESIOSAURUS.**

Another genus is that of the *Plesiosaurs* (Fig. 231). "To the head of a Lizard is united the teeth of a Crocodile;

Odontography, p. 286.

From two Greek words, meaning "near to" and "a Lizard."

a neck of enormous length, resembling the body of a Serpent; a trunk and tail having the proportions of an ordinary quadruped; the ribs of a Chameleon, and the paddles of a Whale."

The *Plesiosaurs* appear to have lived in shallow seas and estuaries, and to have breathed air like the *Ichthyosaurs*, or like the Whale and the Porpoise. The most remarkable character is the extraordinary extension of the neck, to a length nearly equalling that of the body and tail together, and surpassing, in the number of its vertebra (thirty-three), that of the Swan. It is supposed to have "swum upon or near the surface, arching back its long neck like the Swan, and occasionally darting it down at the fish which happened to float within its reach."

The *Pterodactyles* (Fig. 232) constitute another genus.

Fig. 232. **PTERODACTYLES.**

About eight species are now known, the size varying from that of a Snipe to that of a Cormorant. They were considered by Cuvier the most extraordinary of all the extinct animals that had fallen under his observation; and such as, if we saw them restored to life, would appear most unlike to anything that exists in the present world.

These flying reptiles resembled, in some degree, our modern

Dr. Buckland's *Bridgewater Treatise*. We use the words of that eloquent writer, so far as our limited space will permit.

From two Greek words, signifying "wing-fingered," some of the finger-joints being of such a length as to have served as the supports for a membraneous wing. The dotted lines in the figure (232) indicate the supposed outline of this wing, and of the skin of other parts of the body.

Bats. Most of them had the nose elongated, like the snout of a Crocodile, and the mouth armed with conical teeth. Fingers, furnished with long hooks, gave them the means of climbing trees, or hanging in the manner of the Bat and the Vampire. The eyes were of enormous size, apparently as a provision for nocturnal flight. From the remains of insects found with the bones of *Pterodactyles* near Oxford, some

confirmation of the conjecture is derived, that their food was insects; but the larger species of Pterodactyle had head and teeth so much larger and stronger than such prey required, that they may possibly have fed on fishes, darting down upon them from the air. It is probable, therefore, they possessed the power of swimming; and thus qualified for all services and all elements, they realised Milton's description: ' The fiend

O'er bog or steep, through straight, rough, dense, or rare, With head, hands, wings, or feet, pursues his way, And swims, or sinks, or wades, or creeps, or flies."

PARADISE LOST, Book ii. line 947.

ORDER IV. TESTUDINATA. TORTOISES.

"And in his needy shop a Tortoise hung, An Alligator stuffed, and other skins Of ill-shaped fishes." SHAKSPEARE.

LET it not excite surprise that, in the passage just quoted, the word " fishes " should be applied to reptiles. It is still used by the uneducated in speaking of warm-blooded mammalia, which, like the Whale, live in the sea. And let us not look with scorn upon those fallacies; for ever as our own knowledge increases, we should become more sensible of its limited extent, and more indulgent towards the errors of others. Tortoises are distinguished from all other reptiles by having

Latin Testudo, a Tortoise. The Greek chelys signifies a Water Tortoise; the term chelonian reptiles, which is hence derived, is applied both to land and to water species.

the body enclosed between two shields, with apertures for the head, the tail, and the four legs. The jaws are horny and without teeth.

If we look upon one of the common Land Tortoises, slowly pacing along, and clad in its unyielding armour, we are inclined to ask, "Why should it be called a vertebrate animal? Where are the vertebrae and the ribs?"

If we examine the under side of the shield that covers the back of the animal (Fig. 233), the question may with ease be answered. The structure of that shield or, as it is termed, the carapace reveals the vertebrae and ribs, but

Fig. 233. SKELETON OF TORTOISE.

Fig. 233. SKELETON OF LAND TORTOISE with the plastron or lower shell removed. vc, cervical vertebra; dv, dorsal vertebrae; -, ribs; sr, sternal ribs, or marginal pieces of the carapace; o, scapula; cl, clavicle; co, coracoid bone; p, pelvis; , femur; t, tibia; fi, fibula.

strangely altered. The vertebrae have become immoveable. and the ribs so widened as to touch each other throughout their entire length. Still the anatomist can trace, under these and other modifications of structure, the parts with which he is familiar in other animals. In the lower shell, or plastron (Fig. 236), he can, in like manner, recognise the breast-bone (sternum), modified in its structure so as to form a large oval plate.

The number of species at present known is sixty-nine; and these, arranged according to their habits, may be conveniently spoken of as

Land Tortoises, of which there are 15 species.

Freshwater Tortoises 46,,

Turtles, or Marine Tortoises, 8,,

The animals of this order are, more than any other reptiles, limited to the warmer portions of the globe; yet three of the marine species, having at different times been borne by the waves and currents to different parts of the shores of these countries, are, according to established custom, entitled to rank with our indigenous animals.

Among the species thus added to our Fauna is the Hawk's-bill Turtle (*Chelonia imbricata*, Fig. 234). The one best known to epicures is the Green Turtle (*Chelonia mydas*); but the former species is that which supplies the valuable Tortoise-shell of commerce, and to it our observations must be restricted.

"The structure of the whole family is admirably adapted to their marine habits. The body is flattened so as greatly to facilitate their progress through the water; the feet are formed into the most perfect oars, by means of which they are propelled

The other two species are the Coriaceous Turtle *Splangis coriacea* and *Chelonia caouana*.

Fig. 234. HAWK'S-BILL TURTLE.

with considerable force and velocity." "The Green and Hawk-billed in particular," says Audubon, "remind you, by their celerity, and the ease of their motions, of the progress of a bird in the air." They feed on sea-weeds, fishes, mollusca, and Crustacea. The jaws are strong and firmly articulated; the horny beak, which bears some resemblance to the bill of a Hawk, is very hard, and the edge sharp.

The annual resort of the various species of marine Turtles to the land, for the purpose of depositing their eggs, is one of the most interesting points of their history. On the island of Ascension, on the shores of the Gulf of Florida, and in many other places, innumerable multitudes arrive for this purpose during the early part of the summer. The eggs, amounting to one hundred and fifty or two hundred, are laid in a hole scraped on the beach, they are then covered with sand; and the Turtle, having accomplished the object of her mission, retreats with all speed to the water, t

As the flesh of this species is not considered very palatable, the Tortoise is pursued and captured solely for the value of its shell. It is taken on the west coast of New Guinea, at Cuba, and at various other localities; but the Tortoise-shell which comes from the Pacific Ocean is considered much more valuable than that of the Atlantic.

The River Tortoises (*Trionycidae*) are exclusively carnivorous, and eat their food in the water. They are without scales, and are hence called "soft Tortoises." In the Ganges they are very numerous, and prey like the Gavials on the bodies of the natives floating down the stream, j The feet are webbed. The Marsh Tortoises (*Emydce*) are found about lakes, ponds, and small rivers, and swim with considerable

Bell's British Reptiles, p. 2.

f The description given by the poet is too appropriate to be omitted:

"The pregnant Turtle, stealing out at eve, With anxious eye and trembling heart, explored The loneliest coves, and in the loose warm sand Deposited her eggs, which the sun hatch'd; Hence the young brood, that never knew a parent, Unburrow'd, and by instinct sought the sea: Nature herself, with her own gentle hand, Dropping them, one by one, into the flood, And laughing to behold their antic joy, When launched in their maternal element." t Swinson, p. 116. MONTGOMERY'S "PELICAN I SLAND."

facility. In them also the feet are webbed. The food consists of Fishes, Amphibia, Insects, Molluscs, and carrion. Some which inhabit the waters of Carolina and South America are called Alligator Tortoises, and are remarkable for their activity and for the great strength of their jaws.

The Land Tortoises (Testudinidcc) are entirely herbivorous; the feet are blunt, and furnished with short claws. The species best known in this country is the (Testudo Grecca, Fig. 235, 236). When at liberty, it buries itself towards

LAND TORTOISE.

235. Upper Surface. 236. Lower Surface.

the beginning of winter, and remains in its dormitory until spring.

The great longevity of these creatures seems to be one of the most remarkable circumstances in their history. One is recorded as living at Peterborough whose age must have been about 220 years. "Bishop Marsh's predecessor in the see of Peterborough had remembered it about sixty years, and could recognise no visible change. He was the seventh bishop who had worn the mitre during its sojourn there." The weight of this animal was 13 K)S. yet it moved with apparent ease, though pressed by a weight of eighteen stone.

Mr. Darwin mentions the great abundance of Tortoises in all the islands of the Galapagos Archipelago. These creatures sometimes grow to an immense size; he had been told of some so large that six or eight men were required to lift them from

Extracted from Murray's "Experimental Researches," as quoted in a foot-note to Sir William Jardine's edition of "White's Selborne."

VOL. II. E the ground. They are fond of water, travel great distances for it to springs on the elevated grounds, and drink large quantities. From this circumstance it occasionally happens, that the inhabitants of the lower district, when overcome with thirst, will kill a Tortoise for the sake of the contained water. "They believe," says Mr. Darwin, "that these animals are absolutely deaf; certainly they do not hear a person walking close behind them. I was always amused, when overtaking one of these great monsters as it was quietly pacing along, to see how suddenly, the instant I passed, it would draw in its head and legs, and, uttering a deep hiss, fall to the ground with a heavy sound, as if struck dead. I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away; but I found it very difficult to keep my balance."

Were we to give full credence to the authority of Pliny, we could not doubt, notwithstanding what has just been mentioned, that Tortoises have sadly dwindled from their former amplitude; for he expressly informs us, "there he found Tortoises in the Indian Sea, so great, that only one shell of them is sufficient for the roof of a dwelling-house." Exaggerated as this statement may appear, if applied to existing species, it is literally true respecting some which lived in remoter periods another instance of how the light of Fiction "pales her ineffectual fire" before the brightness of Truth.

The fact to which we advert may be briefly told. In the north of India, and from the Sewalik Hills, which form a lower chain of the Himalaya Mountains, great numbers of the fossil remains of vertebrated animals were discovered by Dr. Falconer and Major Cautley. Among these were numerous fragments of a gigantic fossil Tortoise, which

after their arrival in London, were exhibited at a meeting of the Zoological Society, and are now in the British Museum. From the relative size of the bones, and portions of the shell of this extinct reptile, as compared with the corresponding parts of recent species, it was estimated that the lower shell (plastron) had been nine feet four inches long, and the upper shell or buckler (carapace) twelve feet three inches; eight feet in

Journal, p. 464. The species spoken of is the *Testudo Indicus*, t Pliny's Natural History. London, 1634. Vol. ii. p. 431. j Vide Proceedings, 26th March, and May 14th, 1844.

diameter, and six feet in height. The foot of the animal when living must have equalled in size that of the largest Rhinoceros. The entire length of the Tortoise, from the most careful admeasurement, was inferred to have been about eighteen feet, and its height more than seven.

These remains were collected during a period of eight or nine years, along a range of eighty miles of hilly country. From the circumstances under which they were met with, in crushed fragments, contained in elevated strata which have undergone considerable disturbance, no perfect "shell," nor anything approaching to a complete skeleton, was found. In 1835, when the first of these fossil remains were discovered, there was no record of any colossal reptiles of this order; and it became a question, "To what animal could these enormous bones have belonged?" Vain, for a long time, was all research and all conjecture; the problem was still unsolved, and the interest attached to its solution continued daily to increase. At length a small Land Tortoise furnished to the investigators the data for its solution. One of its diminutive leg bones resembled in form one of the immense fossils. And, as in the "Castle of Otranto," the helmet which filled the court-yard, the gigantic foot, the colossal hand, and the sword which required a hundred men to carry it, were all associated together; so, when the creature which had borne this ponderous fossil had been discovered, the mystery was revealed, and no difficulty was felt in assigning to every other bone its proper place.

The researches of geologists have shown that several species of both Land and Freshwater Tortoises lived, in former times, in these countries; and the remains of the marine species discovered have been so numerous as to prove that our own seas were at one period more abundantly provided with Turtles, of different kinds, "than the same extent of ocean in any of the warmer parts of the earth at the present day."

Having presented the Tortoise to our readers under so many

The name bestowed on this fossil Tortoise was *Colossochelys Atlas*: the first term literally, "Colossal Tortoise" having reference to its size; the second to an Indian tradition, of the world having been placed on the back of an elephant, which was sustained on a huge Tortoise; the creature thus performing the duty of Atlas, who, according to classic fable, supported the world on his shoulders.

t Professor Owen, in a paper read before the Geological Society, 1841.

different aspects, we cannot conclude better than by exhibiting his behaviour when in love! The words are those of Professor Edward Forbes:

"Among Lycian reptiles the Tortoise is the most conspicuous and abundant. The number of these animals straying about the plains, and browsing on the fresh herbage in spring, astonishes the traveller. In April they commence love-making. Before we were aware of the cause, we were often surprised, when wandering among ruins and

waste places, at hearing a noise as if some invisible geologist was busily occupied close by, trimming his specimens. A search in the direction of the noise discovered the hammer in the shape of a gentleman tortoise, who, not being gifted with vocal powers, endeavoured to express the warmth of his affection to his lady-love by rattling his shell against her side."""

Travels in Lycia, by Lieut. Spratt, R. N. and Professor Edward Forbes, vol. ii. p. 67. The species *Avere Testudo Græcca* and *marginata*.

"Birds, the free tenants of land, air, and ocean Their forms all symmetry, their motions grace."

JAMES MONTGOMERY.

WE have arrived at a new region, of a character altogether different from any that we have hitherto traversed. At other times, on crossing the line of boundary, we found the aspect of the country unchanged, and the inhabitants nearest to the frontier so like those from whom we had just parted, that at first sight they seemed members of the same fraternity. But such is not the case here; the cold-blooded reptiles can never be mistaken for the warm-blooded birds. We have reached a new land: we have come among a strange people. Let us observe their ways, and ask how they have been described by those who have made them an especial object of study.

Birds are oviparous animals; in other words, they are produced from eggs. They breathe by lungs, have warm blood, and a heart with four cavities namely, two auricles and two ventricles. The body is covered with feathers, and is furnished with two wings and two feet.

Connected with this higher organization, we see in birds the power of flight in its fullest development. This alone would separate them from any other class of vertebrate animals. It is displayed in their long migrations, in the rapidity of their course, and in the force with which the Eagle, "towering in his pride of place," swoops upon his quarry.

This power of flight is, of itself, a singular and interesting subject, connected with the feathered tribes. It is one of those wonders which may be viewed every day, would we but open our eyes to see and our minds to consider them.

Let us, for a few moments, endeavour to divest ourselves of our familiarity with the phenomenon. "Let us," to use the words of the Bishop of Norwich, 'suppose a person to Familiar History of Birds, vol. i. Introduction, p. 3.

have grown from infancy to manhood, without ever having heard of a bird. He sees that the light snow-flake is unable to remain suspended in the air; that the still lighter thistledown, when no longer supported by the breeze, has a tendency to fall to the ground; and yet he is told that there are tenants of the air, countless as those of earth and water; that some, of considerable size and weight, can journey on their way above the clouds, and with a facility and speed far exceeding that of the swiftest-footed animal. He may, indeed, from observing that cork and light bodies, when plunged in water, rise to the surface, conceive the possible existence of a lighter substance than air, capable, by the same laws of nature, of rising above the earth; if a philosopher, he may even discover the inflammable and lighter gas by which a balloon ascends, with the weight of a man attached; but how shall he lift a substance heavier than the air and how guide its proi through the air? Show him the weighty body of an Eagle or a

Swan; tell him their living history, and he may reasonably doubt your fact, and deny that these things could be."

To understand the nature of the mechanism by which flight is effected, let us attend, in the first instance, to the structure of the skeleton of birds; and next, to the peculiarities connected with their respiration.

Skeleton. The neck of birds is, in general, longer and more moveable than that of quadrupeds. As it is by means of the beak that their food is picked up from the earth, the neck, or cervical part of the vertebral column, is longer in proportion as the bird is more elevated by the length of its legs. In swimming birds, which, like the Swan, plunge their head into the water to take their prey, the length of the neck surpasses that of the trunk. The number of vertebrae differs much, according to the different species of bird. It is commonly twelve or fifteen; but in the Sparrow it is only nine, while in the Swan it reaches the extraordinary number of twenty-three. It is to this bountiful provision that this bird owes much of its grace and elegance; and this characteristic feature is therefore justly noticed by the poet: ' The Swan, with arched neck

Between her white wings, mantling proudly, rows Her state with oary feet." PARADISE LOST, Book vii,

The Wild Swan weighs 2"

The joints of the neck are not only numerous, but are made to work on each other with great ease and freedom, and are furnished with numerous projections, to which the muscles are attached. Some of these are shown in the annexed figure (Fig. 237).

Fig. 237. SKELETON OF THE OSTRICH.

For the vertebrae of the back a different arrangement is required; strength, not flexibility, is the object; and, accordingly, in most birds they are united together, and are consequently immoveable. They thus serve not merely as supports for the ribs, but have the solidity which is needful to furnish points of support for the wings also. So beautifully, however, are those structures modified, that in birds which do not fly, the consolidation of the joints of the back-bone does not take place, and some degree of movement is thereby secured.

This is exemplified in the Ostrich (Figs. 237 249), and in the Cassowary (Fig. 238).

Fig. 233. CASSOWARY.

Another peculiarity prevails in the birds just mentioned. The breast-bone (sternum, Fig. 239) never presents the projecting ridge, or keel, which we notice on the birds used as food in these countries. This keel serves an important office, as it increases the power of action in the muscles by which the wing is moved. It is large in proportion to the power of flight; but in birds which cannot possibly fly, and have only the rudiments

Fig. 239. STERNUM, OR BREASTBONE. of wings, the keel is altogether wanting.

s, sternum; sc, scapula; f, clavicle; , keel; c, coracoid; r, sternal ribs.

On each side of the well-known bone which is called the " merry-thought " (furculum), is one of a less symmetrical form, one extremity being thin and flat, while the other is spread out into a stronger and broader shape. If these bones be examined with reference to their uses in the framework of the bird, we find that the thinner side of the last mentioned is, in fact, one bone, the broader side another bone, t constituting the great support of the shoulder; and that the " merry-thought " is composed of two

joined together, forming a figure like that of the letter V, the whole being so many buttresses to keep the shoulder joint firm and steady.

It may not be uninteresting to contrast the skeleton of the Ostrich (Fig. 237) with that of the Vulture (Fig. 240), and

Fig. 240. SKELETON OF TUB VULTURE.

to observe the difference they exhibit in the bones of the wing, and several other particulars.

The bones of birds are not, "however, remarkable only for their form or arrangement, but also for a peculiarity of

The Scapula. f The Coracoid. J The Clavicles.

vc, cervical vertebrae; vs, sacral vertebrae; vq, caudal vertebrae; st, sternum; cl t clavicles; fi, humerus; o, bones of the fore-arm; ci, carpus; ph, phalanges; , femur; t, tibia; ta, tarsus.

structure by which great lightness is combined with strength, and the hollows of the bones in the adult birds are filled not with marrow, but with air. This remark is inapplicable to aquatic birds like the Penguin, which are unable to fly, but refers to those which, like the Eagle or the Swift, have the power of flight in its full development. In them, the bones, even to the extremities of the body, can, at the pleasure of the bird, be filled with air, the buoyancy of which is increased by the high temperature of the interior of the body. Thus we observe the opposite qualities of great strength and great lightness so admirably combined, that the greatest architects or engineers would here find their utmost skill surpassed, and learn how imperfect is human mechanism, compared with that evinced in the structure of every individual of those countless myriads by which the air is traversed.

Temperature. The circulation of the blood in birds need not here be dwelt upon; its leading features are shown in the accompanying figure (Fig. 241); but it is worthy of remark, that the temperature of their bodies is, in some instances, several degrees higher than that of man. The blood heat of the human body is 98, and a thermometer held in the hand will not reach to within two or three degrees of that temperature; but, placed under the wings of different birds, it will rise to upwards of 100, and sometimes even to 110. This great amount of internal warmth gives to birds a power of enduring cold which, to our ideas, seems incompatible with their habits. As an instance of this, we may mention that, on the bleak shores of Terra del Fuego, Humming-birds were seen, during a snow-shower, hovering over the expanded blossoms of a Fuchsia. What a strange sight! The Hummingbirds and the snow the representatives of the Tropic and the Arctic regions united in the same picture.

Respiration. The lungs of birds (Fig. 242) do not fill the cavity of the chest; they adhere to the ribs, and have many openings through which tubes pass, conveying the air to the numerous air-cells distributed throughout the body. By means of this apparatus every part of the body can be inflated, the bones themselves rendered buoyant, and air propelled even I owe the knowledge of this fact to the kindness of my valued friend, Captain Thomas Graves, R. N., H. M. S. Volage, and who at the time was one of the officers in the expedition under command of Captain King, in whose " Voyages " it is also recorded.

into the quills of the feathers. In the case of a wounded Heron, respiration was carried on for an entire day through a broken portion of the wing-bone.

Covering. Feathers, the peculiar and appropriate vesture of birds, present every variety of texture and of tint that the eye could desire, and far more than the imagination could. Lingual artery.

Trachea.

External carotid artery.

Aorta.

Renal artery.

Tschiatic artery.

Femoral artery.

Sacral artery.

Fig. 241. ARTERIAL SYSTEM OF A BIRD.

conceive. We see them in the Eagle compact and firm, in the Ostrich loose and curling, in the Penguin reduced to rudiments, resembling the scale-like covering of a fish, rather than Linnaean Transactions, vol. xi. p. 11.

that of a bird. The poet, in his description of their plumage, has in no way "o'erstepped the modesty of nature:"-

"In plumage delicate and beautiful, Thick without burthen, close as fishes' scales. Or loose as full-blown poppies to the breeze; With wings that might have had a soul within them, They bore their owners by such sweet enchantment."

MONTGOMERY'S 'PELICAN ISLAND.'

Fig. 242. LUNGS OF A BIRD.

By man, in a rude state of society, feathers were used for trimming his arrows, for decorating his person, and on all occasions of unusual ceremony and state. At present they are no less valued. Wanting them, the most splendid pageants would lose much of their effect, and "the plumed troop" be shorn of a grace which no other part of its panoply could supply.

We must at present consider feathers rather in relation to the birds themselves, than to the purposes of use or ornament to which they are applied by man. One obvious advantage to the birds is that of maintaining the warmth of their bodies, or that of their eggs at the time of incubation. All their uses, however, we can but faintly imagine; we know not in of the bronchial tubes, in its natural state; that to exhibit the bronchial how many ways their difference of structure and of colour may cause them to be acted on "by the absorption or radiation of heat, the action of light, or of electricity. Viewed merely as a covering for the body, we find in aquatic birds a wise provision to convert them into efficient non-conductors of heat, by rendering them impervious to the water. Certain glands, situated near the tail, secrete an oily matter, which is spread by the bird over its feathers, and constantly renewed. By this means the plumage remains unwet, even in the water; and the stratum of air between the body of the bird and the surface of the feathers being a bad conductor of heat, the vital warmth of the body is not dissipated. Limiting our consideration to another of their most obvious uses, let us view them as portions of the wings. The feathers of the wing are named according to the part from which they have their origin, and the bones are regarded as representing

those of the fore-leg of quadrupeds, or the arm of man. Those feathers that grow on the part which corresponds to Fig. 243. WING OF FALCON.

our hand are called the primaries (Fig. 243); those on what may be called the fore-arm the secondaries; and those on the part analogous to that between our elbow and our shoulder (humerus) are named the tertiaries.

Every one has noticed the quickness with which the wings can be closed or expanded, and the compact space in which they are shut up when not in use; but, regarded merely as a piece of mechanism, their perfection is, perhaps, still better evidenced by the number of hours during which they can continue in active operation, without fadigue to the bird by whose exertions they are moved. The Swallow forms a good and familiar illustration of this remark. During the time this bird is employed in building its nest, or catering for its young, its activity is ceaseless, and is interrupted only by the brief intervals of rest attendant on the delivery of the material or of the food.

Perhaps the most striking illustration of long-sustained powers of flight is afforded by the Frigate or Man-of-war- p. primaries; s, secondaries; t, tertiaries.

bird (Fig. 244), which abounds both in the Atlantic and Pacific Oceans. The extent of wing is, probably, nine or ten feet, though twelve, and even fourteen feet have been stated. With these ample pinions it fearlessly wings its way over the ""."

Fig. 244. FRIGATE-BIRD.

ocean, and is frequently found leading a life of ceaseless rapine at a distance of more than a thousand miles from the nearest shore. Its support is derived exclusively from the sea. yet it is never known to rest upon its surface. " Supported in its unlimited flights by the strength and expansion of its wings, and aided by the singular mechanism of its tail, and the buoyant nature of the inflated sac which distends its throat, it seems to be an inhabitant of the air rather than of the land, where it resorts alone for the duties of its nest, or of the water, over which it only hovers for its prey."

When navigators give us detailed accounts of the habits of a bird which even the naturalist describes as an inhabitant of the air rather than of the land or of the water, it is not surprising that the idea was at one time current, that in the sunny islands of the East there were birds whose lives were passed upon the wing, and to whom, as they never perched, feet would have been unnecessary appendages. We allude, of course, to the Birds of Paradise, more fully noticed hereafter.

The elaborate provision made for the buoyancy of birds is so remarkable a characteristic of their structure, that we shall Vigors in Linn. Trans, vol. xvi. p. 419.

bring forward another example of its perfection in the Gannet or Solan Goose (*Sula lassana*, Fig. 245), of our own shores.

Fig. 245. GANNET.

This bird is very abundant in Norway and in the Hebrides: and, farther south, the Craig of Ailsa, the island of St. Kilda, and the Bass Rock in the Firth of Forth, are favourite breeding-places. So great are their numbers, that the inhabitants of St. Kilda, according to Martin, consume annually 22,000 young birds of this species as food, besides an immense quantity of the eggs. In more remote localities, the birds are not less numerous.

The Gannet, when searching for food, flies a short way above the surface of the water, and, on seeing a fish, rises into the air, and descends with such rapidity and

force as to secure its prey. Some idea of the power of its descent may be formed from a circumstance related by Pennant. One of these birds, flying over Penzance, saw some pilchards spread out upon a fir plank about an inch and a half thick, and which was used

Buchanan, in his View of the Fishery of Great Britain, conjectures that the Gannets of St. Kilda destroy, annually, one hundred and five millions of herrings. In Sir Walter Scott's "Antiquary," this bird is mentioned as "the relishing Solan Goose, whose smell is so powerful that he is never cooked within doors." The figure of this bird (Fig. 245), and that of the Diver (Fig. 281), are copied from Yarrell.

in the curing of tlic fish, and darted down with such violence that it struck its bill quite through the hoard, and broke its neck. Pennant adds, that these birds are sometimes taken at sea by a similar deception, a fish being fastened for the purpose to a floating plank.

But perhaps a juster estimate of the impetus of the descent may be formed from the depth to which it propels the bird in the water. Respecting this we possess the means of accurate information; for Gannets are not unfrequently found entangled in fishing-nets, and the depth at which these nets are fixed is ascertained. Thus, at Ballintrae, on the west coast of Scotland," and not remote from the Craig of Ailsa (which has been mentioned as one of their haunts), the Gannets are not unfrequently taken in nets sunk to the depth of from nine to twenty fathoms, and sometimes to that of thirty fathoms. On one occasion, so many as 128 of these birds were thus captured at one time, and in their struggles brought the nets with their sinkers and fish to the surface.

The Gannet swims high in the water, buoyant as the foam which crests the wave on which it rides. Its flight and its swimming evince its extreme lightness; its force of descent no less establishes its possession of a certain degree of density. How are these opposite qualities united in the same individual? On this point we are not left to conjectures, but can appeal to facts which anatomists have made known from a careful examination of its structure. Thus, a Gannet which died in the Zoological Gardens of London, was examined by Professor Owen, chiefly with reference to the air-cells, which, in this bird, as in the Pelican, have a most extensive distribution. By means of a gentle but continued inflation through the wind-pipe, the integuments of the whole of the lateral and inferior parts of the body rose, and the air-cells seemed completely filled, especially that which is situated in front of the merry-thought. Further investigation showed that a free communication existed among these, with the exception of that in front of the breast. This cell was found to be of a globular form, about four inches in diameter, and communicating directly with the lungs themselves. Numerous strips of muscular fibre passed from various parts of the surface of

A fathom is six feet. The facts are recorded by Mr. Win. Thompson, Magazine of Natural History, vol. ii. No. 13. f Proceedings of Zoological Society, 1831.

the body, and were attached to the skin; and a beautiful fan-shaped muscle was also spread over the anterior surface of the large air-cell just mentioned. "The use of these muscles appeared to be to produce instantaneous expulsion of the air from these external cells, and by thus increasing the specific gravity of the bird, to enable it to descend with the rapidity necessary to the capture of a living prey, while swimming near the surface of the water."

This is one of those beautiful adaptations of means to an end which Natural History records in every department. " The descent of the Gannet on its prey has been, not inaptly, compared to that of an arrow, the beak of the bird forming the arrow-head, and the body and wings the feathered shaft of the weapon we here have the secret of its heavy fall; the same machinery restores the buoyancy at the proper moment, and the bird rises with its fish aloft."

Moulting. The plumage of birds is periodically renewed, and the process of this change of feathers is termed ' moulting.' " The aspect of the bird, in many instances, changes, not only with age, but also with the season; the summer dress, as we shall have occasion to mention, is often very unlike that of the winter. The changes in the plumage of birds have been investigated, with great care, by Mr. Yarrell; and, in the opinion of that able zoologist, the different appearance which it presents may be explained, 1st. By the feather itself becoming altered in colour; 2d, By the birds obtaining a certain addition of new feathers, without shedding any of the old ones; 3d, By an entire or partial moulting, at which old feathers are thrown off, and new ones produced in their places; and, 4th, By the wearing off of the lengthened lighter-coloured tips of the barbs of the feathers on the body, by which the brighter tints of the plumage underneath are exposed.

In spring, the change which takes place prior to the pairing season is to be attributed to the first two modes; and at that time, also, there is a partial moulting of old feathers a laying-aside, as it were, of a portion of the warm garments of winter. The entire moulting is that absolute change of feathers which takes place in autumn.

Digestive Organs. If, quitting for a moment the consideration of the feathered tribes, we cast our eyes on those of the next and highest division of vertebrated animals, we find the mammalia subsisting on a great variety of food on grasses, grain, fruit, seeds, and herbage on insects, worms, and mollusca on the flesh of various reptiles, fishes, birds, and on that of animals of their own class; and, if we examine the structure of their mouths, we find that they are furnished with teeth so especially adapted for the several varieties of food, that the habits of the animal can with certainty be predicted from a glance at these efficient organs. Had we never seen a bird, and were required to describe the structure necessary to enable a race of feathered, two-legged animals to subsist on the like variety of food, we would probably consider a supply of teeth, resembling those of the mammalia, but less in size, as the very first requisite. These teeth would require to be fixed in jaws of corresponding strength and weight, and these jaws to be moved by muscles of sufficient power an arrangement inconsistent with the lightness which is absolutely essential. This problem we have supposed has already received its solution. The organs we would have thought most needful are altogether omitted, and their functions are performed by an apparatus so unlike in structure, and yet so efficient in its working, that it declares, on the part of its Artificer, an amount of skill, of knowledge, and of power alike unlimited. The bill, being the instrument by which food is taken, first demands our examination. It is, externally, of a horny texture, and exhibits great variety in its form, and no less in the uses to which it is subservient. In some tribes, it is simply an organ for prehension, used in picking up grains or worms. In others, it is employed to separate the seeds from the husks. In the Ibis (Fig. 278), it is long and bent downwards; in the Avocet (Fig. 246), it is long,

and curved upwards; in the Snipe it is a probe; in the Swallow, a fly-trap; in the Duck, a

Fig. 246. BILL OP AVOCET. 111., shovel, and at the same tune a strainer; by the Parrot it is used as a help in climbing; by the Vulture (Fig. 255) as a carving knife for his gory feast. But, supposing the food to be procured, it is needful, in the next place, that there should be some convenient receptacle into which it can be instantaneously transferred, until wanted. In some birds, which, like the Swift, live upon insect prey, seized when on the wing, the upper part of the throat is so large as to answer for this purpose. In the Pelican, a peculiar pouch is attached to the lower jaw (Fig. 247), and in this a goodly store of fish can be carried about. In the Cormorant, the gullet itself is dilated, so that it is not unusual, when the bird has got a fish too large to be swallowed at once, to see the tail hanging for a time out of its mouth. But the plan which is most usual, is that which may be exemplified in the

Fig. 247. PELICAN.

digestive system of a common fowl (Fig. 248). The gullet (oesophagus) is suddenly expanded, forming a bag or chamber, known as the crop. Beneath this there is a slighter expansion, which forms the second or membranous stomach, in which the food is softened by the action of what is called the gastric juice. From this the food passes on to the third stomach, in which the process of digestion is completed. In flesh-eating birds, this stomach is thin and membranous; but in those which feed on grain, the sides of it are of considerable thickness, and, being moved by powerful muscles, act as a mill in grinding down the food. Many who see the gizzard of a fowl at table know that it serves in the economy of the bird as a grinding machine; but comparatively few know that the gizzard is actually the stomach itself, which, thickened in its coats, performs the same office as the teeth of the graminivorous quadrupeds.

Fig. 248. DIGESTIVE APPARATUS OF A FOWL.

The action of the gizzard is expedited by small pebbles and other hard substances swallowed by the fowl. In the Ostrich (Fig. 249), this instinctive action prevails to such an extent, that in the stomach of one were found pebbles sufficient to fill a large glass bottle; and as the Ostrich will e, oesophagus; C, crop; v, ventriculus succenturiatus; g 1, gizzard; , liver; gb, gall-bladder; 6, bile-ducts; p, pancreas; d, duodenum; c, coeca; s, small intestine; L, large intestine; O, oviduct.

swallow metals with equal readiness, popular credulity, in former times, went so far as to assign to it the power of digesting these substances; and many are the allusions in the older writers to this supposed power of " the iron-eating Ostrich."

Fig. 249. AFRICAN OSTRICH.

Senses. The two senses which appear to be developed in the highest degree in birds are those of sight and of smell. The arrangements connected with the eye, regarded as an optical instrument, are, in all their details, replete with evidence of design. It has to perform a variety of functions, and demands a corresponding variety in the adjustment of its several parts. It must be fitted for vision at the altitudes to which birds of prey soar, and equally fitted for vision near at hand. It must be adapted for rays of light passing through

Mr. Bennett, in *Gardens and Menageries*, quotes the following lines, as illustrative of the prevalence of this belief. The author is Skelton, a laurelled poet of the reign of Henry the Eighth: " The Estridge that will eate An horshowe so greate, In the steade of meat; Such fervent heat His stomake doth freat." Horse-shoe.

media of very different densities, and of different degrees of transparency. Conditions have, therefore, to be fulfilled with regard to the eye of birds, which are not required in the best optical instrument of human construction; and, at the same time, it is needful that the focal distance, fitted for near or for distant vision, should be adjusted with a rapidity very different from the "rack and pinion" adjustments of our most skilful opticians. Details connected with this subject would here be out of place, and must be sought for in works of a less elementary character.

One obvious peculiarity may, however, be mentioned: birds possess, not two, but three eyelids. The third, termed the nictating membrane, lies in the inner angle of the eye when not in use. By the action of powerful muscles, it can in a moment be swept over the surface of the eye, and then by its own elasticity spring back to its former place. It is membranous, and somewhat transparent; and some authors who describe the Eagle as gazing on the sun, assert that he does so by means of the protection which this membrane affords. f

Smell. The sense of smell in birds has been subjected to various experiments, to ascertain the extent to which it exists; and the development of the olfactory nerves in more than one species has been examined by Professor Owen. J A Vulture, which formed the subject of one of his investigations, was the Turkey Buzzard (*Vultur aura*), a bird extremely abundant in Jamaica, where it is known by the familiar name of " John Crow." It feeds on carrion, and its services are considered so valuable, that the killing of one within a certain distance of the principal towns is an offence punishable by fine. The notes of Professor Owen prove the existence in this Vulture of a well-developed organ of smell. The same fact is established by the observations of Mr. Sells. It is to be recollected that, in hot climates, the burial of the dead commonly takes place in about twenty-four hours after death, on account of the rapidity with which decomposition takes place. " On one

Jones's Outline, p. 609. Yarrell's *Birds*, 1st edition, vol. i. p. 11, 14, and 138.

f The poet thus refers to the popular belief:

"Nay, if thou be the princely Eagle's bird, Show thy descent by gazing 'gainst the sun."

KING HENRY VI. Part iii. Act ii. scene 1. J Proceedings of Zoological Society, March, 1837.

occasion," says he, "I had to make a post-mortem examination of a body within twenty-four hours after death, in a mill-house completely concealed; and while so engaged, the roof of the mill-house was thickly studded with these birds" (the Turkey Buzzards). On another, " the family had to send for necessaries for the funeral to Spanish Town, distant thirty miles, so that the interment could not take place until noon of the second day, or thirty-six hours after his decease; long before which time and a most painful sight it was the ridge of the shingled roof of his house, a large mansion of but one floor, had a number of these melancholy-looking heralds of death perched thereon, besides many more which had settled in the vicinity. In these cases,

the birds must have been directed by smell alone, as sight was totally out of the question."

The obtuseness of the sense of smell, in another species, seems to be no less clearly established. Mr. Darwin saw, at Valparaiso, between twenty and thirty Condors, which were kept in a garden there, and fed once each week. The Condors were tied, each by a rope, in a long row at the bottom of a wall; he was thus enabled to try the following experiment: Having folded up a piece of meat in white paper, he walked backwards and forwards, carrying it in his hand, at the distance of about three yards; but no notice whatever was taken. He then threw it on the ground, within one yard of an old cock bird, which looked at it for a moment with attention, but then regarded it no more. Mr. Darwin pushed it closer and closer with a stick, until the Condor touched it with his beak; the paper was then instantly torn off with fury, and, at the same moment, every bird in the long row began struggling and flapping its wings.

The controversy between some authors, as to whether Vultures are guided to the carrion on which they feed by the sense of sight or that of smell, is like the combat of the two knights, as to whether the statue bore a shield of gold or of silver. It was composed of both. And, in like manner, there seems no good reason for doubting that both senses are made

Penny Cyclopaedia, article Turkey Buzzard.

f Zoological Proceedings, March, 1837. The same evening on which Professor Owen's communication on the development of the olfactory nerves was read.

Journal, p. 222. Voyage of the Adventure and Beagle.

to contribute to the welfare of the birds, by directing them to their prey. The far-sighted eye sees it from the clouds, and the characteristic flight of the Vulture, as it descends to the feast, reveals to its brethren the fact that a repast is spread for them; and from all quarters they hasten to participate. And, again, when near at hand, under the screen of cliffs, or the thick-tangled vegetation of tropical forests, the sense of smell reveals the hidden carcas, and tempts around it those who act an important part as agents for its removal. Different species may be supposed to possess these powers in varying degrees of perfection, so that each may most efficiently perform its allotted duty.

The Vultures are not the only birds by which the removal of decaying animal matter is carried on; it is shared by those belonging to other orders. Thus, in India, there is another whose services are no less valuable, and whose appearance is altogether different. It is a gigantic Crane, called the Adjutant (Fig. 250). This bird, and a species found in Senegal, furnish the valuable marabou feathers. It is called the Pouched Adjutant, from a bag or pouch on the middle of the neck; and which pouch has been likened by Cuvier to "a large sausage." Its utility as a scavenger is so great, that the bird is not only permitted to remain unmolested, but is held in great estimation, and, from superstitious feelings, even regarded with reverence. It is a voracious feeder, and gulps down its food whole. It has been known to swallow a leg of mutton five or six pounds weight; and Sir Everard Home states, that in the stomach of one a Land Tortoise ten inches long, and a large black Cat, were found entire.

Removal of Decaying Animal Matter. We would wish here to call attention to the provision so abundantly made for

Fig. 250. POUCHED ADJUTANT.

the removal of putrefying substances, which would soon taint the atmosphere, and spread disease and death around. Many birds, besides those we have named, share in this labour, converting into nourishment that which would otherwise prove baneful. Among the mammiferous animals, we find some that prey upon the helpless and the dead; and thus the carnivorous tribes, both of birds and quadrupeds, carry into effect the same beneficent provision. But they are not the sole, though they are the most powerful, workers; there are others, both on land and water, whose diminutive size is more than compensated by their countless numbers. Let us revert to some of the invertebrate animals, whose habits have been briefly noticed, and see how numerous are these labourers, how different their structure, yet how effectually they all work together. Even in the brief space to which we have been restricted, we have enumerated, as devourers of organised matter in a state of decay, Infusoria, Star-fishes, Earthworms, Crustacea, Insects, Mollusca, Fishes, Crocodiles, and we now add Birds and Mammals. Each individual acts for himself alone; yet all unconsciously co-operate in carrying out one harmonious design. Without the ceaseless efforts of these heterogeneous labourers, the air, the rivers, and the seas would alike become loaded with impurities, and the earth would soon be converted into one great charnel-house. The wisdom by which a comprehensive scheme for preventing this result has been formed, and the providence by which it has been sustained, speak alike of HIM by whom these animated tribes have been called into existence, and have been gifted with their several capacities.

Migration. At the approach of winter, there are various birds which make their appearance pretty nearly at the same time each year, and leave us early in the spring. They have arrived from regions further north, and have made our islands the southern limit of that periodical change of residence to which we give the term migration. There are others whose appearance in spring we welcome, not only because of the beauty of their flight or their plumage, or the cheerfulness of their notes, but because we know from experience that these feathered visitants are the harbingers of brighter skies and renovated verdure. These lovely heralds of the spring stay with us during the summer, and then wing their way to the south. The British Islands constitute the northern limit of VOL. ii. F their migration. It is now ascertained, that the greater number of these summer birds leave these kingdoms for the north and west of Africa, whence they return annually, with such punctuality, that their appearance is looked for with confidence within a day or two of the particular time.

These few simple facts are nearly all that we can be said to know with certainty on the mysterious subject of migration. It has been asserted that birds change their quarters because of inclement seasons, scarcity of food, and other evils, which are avoided by their change of residence. But if these supposed explanations be scrutinised, they will be found unsatisfactory. The truest philosophy is candidly to avow our ignorance of the subject, and to regard birds as acting under an impulse implanted in their constitution by the Creator. Observation only corroborates, that " the Stork in the heavens knoweth her appointed times, and the Turtle and the Crane and the Swallow observe the time of their coming."!

Several observers have stated, that migratory birds, when in confinement, though plentifully supplied with food, show evident symptoms of restlessness when the period arrives at which their fellows take their departure. So powerful is this migratory instinct, that birds will forsake their young and leave them to perish, rather than not accompany their companions. This proceeding, so contrary to all that we see of the devoted attachment of the parent birds to their offspring, was first observed by Mr. Blackwall, who states J that, in the spring of 1821, a pair of House-martins, after taking possession of a nest which had been constructed in the preceding summer, drew out the dried bodies of three nearly full-fledged nestlings, which had perished in it. About the same time, another pair of House-martins, being unable to dislodge the young, closed up the aperture with clay. This suggested

Several British species were observed, on their migration northward, by Mr. W. Thompson, when on his passage from Malta to the Morea, in H. M. S. Beacon, in April, 1841. *Annals Nat. Hist.* vol. viii. p. 125. f The lines of Pope are highly descriptive and appropriate: " Who bid the Stork, Columbus-like, explore Heavens not his own, and worlds unknown before? "Who calls the council, states the certain day, Who forms the phalanx, and who points the way? God in the nature of each being sounds Its proper bliss, and sets the proper bounds." J In his *Researches in Zoology*.

examination in future years, after the Martins and Swallows had taken their departure; and, each time, several nests were found containing dead nestlings which had been abandoned by the parents. Upon these interesting facts Mr. Thompson remarks: " In the instances above alluded to, the young broods and eggs were deserted late in the season, and I should suppose at the migratory period. The paramount object would then seem to be migration; and, when favourable weather and wind prevail, the love of offspring yields to the stronger impulse, and the parents take their departure. Had this favourable time been long enough protracted, they would have continued to tend their offspring, and bring them to maturity."

Affection for their Young. The instances just mentioned are the exceptions to that ardent attachment to their young which birds evince. If danger threaten, the most timid becomes bold, and is ready to give battle to the assailant, t In the cold-blooded vertebrate animals, the mother, in most cases, is satisfied with depositing the spawn in a suitable situation, or the eggs in what seems a place of security. With this her care for the future progeny is ended, and she experiences nothing of the actual cares or pleasures of maternity. But the proceedings of birds, prior to the exclusion of the young from the egg, and afterwards in regard to the attention bestowed upon them, is in every respect so sedulous, so unceasing, and so replete with tenderness, that it is not in the power of language to convey a picture of affectionate solicitude beyond that which is employed in reference to their ordinary habits. J The exertions made by the parent birds to procure for their helpless young the supply of the requisite food, are so unceasing, and are carried on with such entire forgetfulness of self, as to excite the admiration even of the most incurious. When, therefore, the poet recounts the simple facts which

Annals of Natural History, vol. ix. p. 378.

f " The poor Wren,

The most diminutive of birds, will fight, Her young ones in the nest, against the Owl."

SHAKSPEARE.

The reader will recall to mind, as an example of this, the memorable-words "O Jerusalem, Jerusalem! which killest the prophets, and stonest them that are sent unto thee: how often would I have gathered thy children together, as a hen doth gather her brood under her wings, and ye would not!" LUKE xiii. 34.

observation reveals, he wakens into activity some of our purest sympathies; nor can the naturalist present a picture more faithful than that which is arrayed in the garb of verse: the truth and the poetry are one.

"Some sought their food among the finny shoals, Swift darting from the clouds, emerging soon With slender captives glittering in their beaks; These in recesses of steep crags constructed Their eyries inaccessible, and trained Their hardy brood to forage in all weathers. Others, more gorgeously appparelled, dwelt Among the woods, on Nature's dainties feeding Herbs, seeds, or roots; or, ever on the wing, Pursuing insects through the boundless air; In hollow trees, or thickets, these concealed Their exquisitely woven nests, where lay Their callow offspring, quiet as the down On their own breasts, till from her search the dam "With laden bill returned, and shared the meal Among her clamorous suppliants all agape; Then, cowering o'er them with expanded wings, She felt how sweet it is to be a mother."

MONTGOMERY'S " PELICAN ISLAND."

Nests. We turn from the young birds to those singular habitations in which they are hatched. The smallest amount of observation makes manifest to every one, the 3f great diversity of their situation, structure, and materials. As examples, we may mention the exposed nest of the Sky-lark, built upon the ground, compared with the globular edifice of the Wren, constructed in sheltered situations, and in-

Fig. 251. NEST OF GOLDFINCH.

geniously concealed from view; or the neat and elaborately finished nest of the Goldfinch (Fig. 251), contrasted with the coarser edifice of the Rook or the Magpie.

But, regarded merely as a work of art, some of the nests from foreign countries appear more ingenious and more artistical, though of course not better adapted to the wants of their respective occupants. Thus the nests of the Baya, a bird of Hindostan, are formed of long grass woven together in the shape of a bottle (Fig. 252), and suspended " to the extremity of a flexible branch, the more effectually to secure the eggs and young brood from serpents, monkeys, squirrels, and birds of prey. These nests contain several apartments, appropriated to different purposes." The entrance is at the lower part, so that the parent birds reach it only when on the wing.

Another species, called with groat justice, the Tailor-bird (*Sylvia sutoria*), collects from the cotton-plant, fibres of

Fig. 252. NEST OF THE BAYA. Fig. 253. NEST OF THE TAILOR-BIRD.

cotton, and with them sews two leaves together, the bill being used as a needle. The nest is concealed in the space between the two leaves Fig. 253).

Forbes's Oriental Memoir?, vol. i. p. 48.

In the former part we mentioned (p. 137), that some Caterpillars spin a snow-white canopy, and dwell together in social communities. Among birds we have an example

of their united efforts being, in like manner employed in the construction of a common covering. This is observable in the sociable Grosbeak (*Loxia soda*), a species found about the Cape of Good Hope. These birds construct a roof of grass matted together; and beneath the eaves of the shed thus formed by their joint labour, the individual nests are built (Fig. 254). Some idea of the size and solidity of these structures may be formed from the fact mentioned by Vaillant, that having observed one of enormous size, he despatched some men with a waggon to bring it, and on its arrival he cut it to pieces with a hatchet.

Fig. 254. NEST OF SOCIABLE GROSBEEK.

Organs of Voice. The period when birds are about building their nests, and engaged in attending to the callow young, is that in which our groves become "prodigal of harmony." This may, therefore, be a fitting place to make some remarks on the organs of voice. In birds, they consist of a windpipe, which divides at the lower part into the two branches called the bronchial tubes one leading to each lung (as shown Travels, second series, vol. iii.

in Fig. 242.) At the upper part of the windpipe is an organ (the glottis, or superior larynx) by which the size of the aperture seems to be regulated. At the lower part is placed the true organ of voice in birds (the inferior larynx); and, in all those which possess the vocal powers in the highest perfection, this part is furnished with five pair of nerves. "The tube of the windpipe," says Mr. Yarrell, "is composed of two membranes, enclosing between them numerous cartilaginous or bony rings, forming a cylinder more or less perfect from end to end." The tube differs in its length, its diameter, and its substance, in different species; and in some it exhibits convolutions which modify its powers. "The principle upon which the organs of voice in birds is founded, is that which prevails in wind instruments generally; the notes in the ascending scale being produced by a corresponding contraction of the diameter or the length of the tube, and vice versa."

Such is the description given by physiologists of the mechanism which produces the loud note of the Wild Swan, the booming of the Bittern, the cawing of the Rook, the hooting of the Owl, and the wild screams which, heard amid the native haunts of the sea-fowl, harmonise with the surging sea. Birds, as we all know, can be taught to imitate the tones of the human voice; nor is this limited to the Parrot; the power is enjoyed, among our native birds, by the Raven, the Magpie, the Jay, and the Starling. So distinctly have Ravens been taught to articulate short sentences, that one living at Chatham, "in the vicinity of the guard-house, has more than once turned out the guard, who thought they were called by the sentinel on duty."

The power of imitation reaches, perhaps, its highest perfection in the Mocking-bird of America. So perfect is his performance, that not only the experienced ear of the fowler is deceived, but even birds themselves are imposed upon. In a domesticated state he finds equal scope for the versatility of his powers, and his doings have been most graphically recorded by Wilson, in his American Ornithology: "He whistles for the dog; Cesar starts up, wags his tail, and runs to meet his master. He squeaks out like a hurt chicken, and the hen hurries about, with hanging wings and bristled feathers, clucking to protect its injured brood. The barking

British Birds, vol. ii. p. 71.

f Quoted by Mr. Yarrell, from Swainson and Richardson.

of the dog, the mewings of the cat, the creaking of a passing wheelbarrow, follow with great truth and rapidity."

Distribution. To one who regarded only the powers of flight which birds possess, it might seem easy for beings so endowed to change their abode at pleasure, and not, like the more slow-moving mammalia, be restricted to certain regions; but here, as in every other department of Zoology, the laws of geographical distribution are more potent than the mandate of the king who placed his chair upon the beach, and forbade the approach of the waves "Thus far shalt thou come, and no further."

The number of species is supposed to be about four times greater than that of quadrupeds; and, with the exception of fishes, they are more widely distributed than any other class of vertebrated animals. Mammalia and reptiles are, to a great extent, limited to the warmer regions; but birds are found in every part of the earth, from the equator to the poles.

The number of species is greatest towards the equator, except among the aquatic tribes. Europe is regarded as remarkably rich in the number of its birds, the species amounting, according to a catalogue published in 1840, to 490, arranged in thirty-four families and one hundred and sixty-four genera. It is interesting to observe the comparative numbers belonging to the leading groups:

Rapacious Birds 54 species.

Perching and Climbing Birds 209,,

Scraping Birds 28,,

Wading Birds 97,,

Swimming Birds 112,,

TOTAL. 490 species.

Classification. The number of species at present known to naturalists is in some degree doubtful, for the same bird has frequently appeared under more than one name, in the works of successive authors. Lesson has enumerated 6,266 species; but Mr. Strickland is of opinion that 5,000 species

This and all other information on the subject of distribution is derived from Berghaus's and Johnston's Physical Atlas: a highly valuable work, which has been referred to on the distribution of reptiles.

t By Keyserling and Blasius.

are probably all that can be said to be accurately known. This number is divided into about a thousand genera, and the names and limits of these genera have, from time to time, undergone considerable modification. This will not seem surprising when it is borne in mind, that genera are merely contrivances adopted by writers for the purpose of conveniently grouping together those species which most nearly resemble each other. The word "species" is applied "to such individuals as are supposed to be descended from a common stock, or which might have so descended," "if A species has a real existence in nature. A genus is an abstract idea, a creation of the mind, liable to be overthrown or upreared, contracted, or expanded, according to the mutability of human knowledge. In this little book we do not purpose entering upon the comparative merits of different systems of classification. That system is the best which is founded, not upon any one set of characters, but upon an intimate knowledge of all. The only

true foundation on which it can be reared is that which is afforded by the anatomical structure. Each change of external character is accompanied by a corresponding change of internal organization. "The external parts afford an index to the internal, "f The shape of the organs by which the food is taken indicate the form and structure of those by which it is swallowed and digested. Hence, "if we find a bird having a short-beaked bill and curved claws, we shall not be wrong in inferring that it has a wide oesophagus (gullet) and a large membranous stomach. " But our information is incomplete, and our classification imperfect, unless to a knowledge both of external and internal structure, we add that which is to be acquired by the study of the living objects seen in their native haunts. Thus only can we ascertain to what extent each modification of structure is accompanied by a corresponding change of habit; and until this be done, with regard to foreign as well as to native species, we must not suppose that our classification is perfect and unchangeable.

Vide his excellent Report on "the Progress and Present State of Ornithology," Report of British Association, 1844.

f Archbishop Whately's Logic, book iv. chap. v.

J Macgillivray's British Birds.

Idem. This work contains an instructive and interesting series of plates, exhibiting the modifications of the several parts of the alimentary canal in a large number of native birds.

Succli are the principles which seem now to be generally recognised, even when there exists considerable difference of opinion as to the details by which they can most successfully be reduced to practice. The following arrangement is that which has been adopted by some of our leading British ornithologists:

Order I. RAPTORES-Birds of Prey, as Vultures, Eagles, Owls. II. INSESSORES Perchers, as Sparrows, Linnets, Crows.

III. RASORES Scraping Birds, as Pheasants, Fowls.

IV. GRALLATORES Waders, as Herons, Bitterns.

V. NATATORES Swimmers, as Geese, Divers, Gulls.

According to the general plan we have pursued, we should commence with the swimming birds, and gradually ascend to that group which contains the Falcons and the Eagles, which are regarded as the nobles and the kings of the feathered tribes; but the birds usually placed lowest in the scale, such as Gulls and Terns, do not present the slightest resemblance to the creatures which rank highest, and were the last mentioned in the preceding class. Between certain mollusca and fishes we found so great a resemblance, that a question had arisen as to whether a certain species should be regarded as a mollusk or a fish: between fish and reptiles, again, a similar difficulty occurred; but between reptiles and birds, or between birds and mammalia, there can be no such question. The separation is so well marked, that there is no debateable ground, no border territory. The birds stand out apart from the groups on either side, distinctly isolated. No advantage, therefore, accrues from placing the lowest of the birds next to the reptiles, nor those regarded as the highest next to the quadrupeds. Such an arrangement is also open to the objection, that by most writers the different classes are treated of in the order in which they have been here enumerated; and it is desirable that the learner should be accustomed to the same succession of family and

genera, in this elementary work, that he will meet with in those of a higher character. For these reasons we have resolved on following the course that is most generally pursued, and beginning with, the birds of prey.

We can notice only the leading groups, and even these with great brevity. This must be apparent, when it is recollected that the number of species at present known is perhaps between five and six thousand (p. 324); and that those occurring even in the British Isles, amount to between three and four hundred. We shall therefore only attempt to state what are the points of structure by which the principal divisions are characterised, and bring forward a few of the individuals belonging to each, as exemplifying the habits or economy of their respective families.

ORDER I. RAPTORES. BIRDS OF PREY.

THE Raptorial Birds are distinguished by a strong hooked bill and stout muscular legs. Three of the toes are directed forward, and one backward; they are rough below, and armed with powerful, sharp, curved, retractile talons. They are arranged in three families the Vultures, the Falcons, and the Owls.

I. VULTURID E. VULTURES.

"Above, the mountain rears a peak Where Vultures whet the thirsty beak; And theirs may be a feast to-night Shall tempt them down ere morrow's light. "f

By HON.

The Vultures have the claws, in general, less curved than either the Falcons or Owls, the feet generally naked, and the head in a greater or less degree divested of feathers. None of them are indigenous in these countries; yet as two have been taken here, they are of course included in our Fauna.

The Irish species, according to Mr. W. Thompson's Report, published in 1840, were then about 230; and fourteen or fifteen have since been added.

f " Whet the thirsty beak." The idea of whetting the beak, though current, is erroneous.

One of these is the Griffon Vulture, of the Alps and Pyrenees (*Vultur fulvus*, Fig. 255), caught near Cork Harbour, in 1843. The food of this species is carrion, on which it gorges to repletion, rarely quitting the prey while a morsel of

Fig. 255. GRIFFON VULTURE.

flesh remains; so that it is not uncommon to see it perched upon a putrefying corpse for several successive days. It never attempts to carry off a portion, even to satisfy its young, but feeds them by disgorging the half-digested morsel from its maw. It frequents the North of Africa, as well as Europe, and congregates in considerable numbers when the carcass of some large quadruped forms the banquet. J"

The other is the Egyptian Vulture (*Neophron percnopterus*, Fig. 256), one of which is recorded by Mr. Selby to have been shot in Somersetshire, in 1825. It is this species which Mr. Bruce mentions as frequent in Egypt and about Cairo, where it is called by Europeans " Pharaoh's Hen." These birds are never Fig. 256.-NEOPHRON. molested by the natives, but encouraged and protected, because of their services in clearing away filth and offal. "Every group of the natives has a pair of these Vultures attached to it. The birds roost

Thompson, in *Annals of Natural History*, vol. xv. f Bennett.

on the trees of the vicinity, or on the fences which bound the enclosures formed for their cattle." They differ in size and other particulars from the true or typical Vultures, such as that just mentioned.

The Condor (*Sarcoramphus gryllus*) represents another group remarkable for the "caruncles" or fleshy appendages of the neck (Fig 257), somewhat akin to those seen on the Turkey-cock. Beneath is a white ruff of downy feathers, forming the line of separation between the naked skin above and the true feathers covering the body below. At the early part of this century, such exaggerated ideas, respecting the size of this "bird, were current, even among naturalists, that it was compared to the Roc of eastern fable. It was reserved for Humboldt to destroy these exaggerated ideas, Fig. 257. CONDOR. and to reduce its powers and dimensions to their true limits. The extent of the wings, when expanded, is usually from nine to eleven feet. Humboldt did not himself see any which exceeded nine: one shot by Mr. Darwin measured only eight and a half; but it is still said that some attain so great a size as fourteen feet. J Borne on these wide-spreading pinions, the Condor maybe seen soaring at an elevation of from ten to fifteen thousand feet above the level of the ocean. One is stated to have been seen by Humboldt so high as twenty-two thousand feet. " These birds generally live by pairs; but among the inland basaltic cliffs of St. Cruz." 7 says Mr. Darwin, "I found a spot where scores most usually haunt. On coming suddenly to the brow of the precipice, it was a fine sight to see between twenty and thirty of these great birds start heavily from their resting-place, and wheel away in majestic circles." He describes their flight as beautiful: the Condors moving in large curves, sweeping in circles, descending and ascending without once flapping their wings.

The species of Vulture which seems to form the connecting link between this family and the eagle, is that which the

Yarrell, vol. i.

Patagonia. Journal, p. 220. Bennett, Gardens and Menageries.

natives of the German Alps name the Lammergeyer, or Lamb Vulture. It resembles the eagle in its confident and upright bearing, and is the largest of European birds of prey, measuring, when fully grown, upwards of four feet from beak to tail, and in the expanse of its wings no less than nine or ten. It frequents the highest mountain chains in both Asia and Africa. Of its audacity Bruce relates a striking instance. While that celebrated Abyssinian traveller and his servants were at dinner in the open air, with several dishes of boiled goats' flesh before them, one of these Vultures came flying slowly along the ground, and sat down close to the meat, within the ring which the men had made round it. " There were two large pieces, a leg and shoulder, lying upon a wooden platter; into these he trussed both his claws and carried them off." He was shot on his return for a further supply.

II. FALCONID E.-FALCONS.

' Scaling yonder peak, I saw an eagle wheeling near its brow, O'er the abyss; his broad expanded wings Lay calm and motionless upon the air, As if he floated there without their aid, By the sole act of his unlorded will, That buoyed him proudly up."

J. SHERIDAN KNOWLES' WILLIAM TELL.

This group is distinguished from the preceding by the sharp curved claws, and by the head being in all cases covered with feathers. It includes the Eagles, Falcons, Kites, and Buzzards.

In entering upon this subject, there is one source of error we should sedulously avoid. It is that which invests with human feelings and passions the inferior animals; which makes us prone to regard one as brave, noble, generous, and humane, and another as cowardly, base, selfish, and unpitying. Tried by such a standard, the Eagle embodies all that is great, the Vulture all that is despicable. We forget that both are birds of prey, destined to fill important, though different, parts in the scale of being, and both alike destitute of those higher motives which the use of such phraseology on our part would imply. With this brief caution, we shall not hesitate to avail

Bennett.

ourselves of the language of the poet, nor seek to deaden the warm tints which glow upon his pictures.

Two species of Eagle the Golden and the White-tailed are known as permanent residents in these countries. The addition of another to our Fauna was an occurrence of some interest to ornithologists. This third species is an Inhabitant of the Apennines, and other mountains of central Europe, and is known as the Spotted Eagle (*Aquila nevia*). Mr. R. Davis, of Clonmel, states that it was shot in the month of January, 1845, on the estate of the Earl of Shannon, county of Cork, and was at the time in a fallow field, devouring a rahhit. Another hird, similarly marked, hut reported to have heen of a lighter shade of hrown, was shot at the same place within a few days afterwards, but was not preserved.

Fig. 258. GOLDEN EAGLE.

The White-tailed, or Cinereous Sea Eagle (*Haliceetus albicilla*) is somewhat less in size than the Golden Eagle. It is much more abundant, and it seems in its habits to approach more nearly to the Vultures. We shall, therefore, convey a better idea of the habits of "the wide ruling Eagle," by appropriating our limited space to the Golden Eagle (*Aquila chryswetos*, Fig. 258).

In a letter to Mr. Yarrell vide British Birds.

This species, though occasionally taken in England, haunts more especially the mountainous districts of Scotland, and of the north and west of Ireland. In Mr. Selhy's splendid illustrations of British Ornithology are two figures of this hird. These have suggested to a reviewer of that work a description so vivid, that it enables the reader at once to realise, in his own mind, many of its characteristic features.

"The Golden Eagle leads the van of our birds of prey, and there she sits in her usual carriage when in a state of rest. Her hunger and her thirst have been appeased her wings are folded up in dignified tranquillity her talons, grasping a leafless branch, are almost hidden by the feathers of her breast her sleepless eye has lost something of its ferocity and the Royal Bird is almost serene in her solitary state on the cliff.

"But, lo, the character of the Golden Eagle when she has pounced and is exulting over her prey! With her head drawn back between the crescent of her uplifted wings, which she will not fold until that prey be devoured eye glaring with cruel joy neck plumage bristling tail feathers fan-spread, and talons driven through the victim's entrails and heart there she is new alighted on the edge of a precipice, and fancy

hears her yell and its echo." ' The week-old Fawn had left the Doe's side but for a momentary race along the edge of the coppice a rustle and a shadow, and the burden is borne off to the cliffs of Ben Nevis."

The power of vision in this tribe is very extraordinary. This fact has been long known; so long, indeed, that the classical reader will at once remember that it is mentioned by Homer, in his description of Menelaus: -" The field exploring, with an eye

Keen as the Eagle's, keenest-eyed of all That wing the air, whom, though he soar aloft, The Lev'ret 'scapes not, hid in thickest shades, But down he swoops, and at a stroke she dies."

ILIAD, COWPER'S TRANSLATION, xvii. 674.

Fawns, Lambs, and Hares, with smaller quadrupeds and birds of various kinds, constitute the food. It generally kills its own game, but not invariably. Mr. Thompson records the

Blackwood's Magazine, Nov. 1826.

f Papers on the Birds of Ireland, in the Magazine of Zoology and Botany and Annals of Natural History. To this series, with permission of the author, we make frequent reference.

capture of three of these birds at Glenarm Park, County Antrim, the bait employed in each instance being the body of a Duck or a Lamb. So great is the quantity of food they collect, when rearing their young brood, that a poor man in the county of Kerry got a comfortable subsistence for his family, during a time of famine, by robbing an Eagle's nest. A similar occurrence took place at Glenariff, county of Antrim, in the early part of the present century. " One of a pair of Eaglets, taken from a nest there, was so placed, that during the summer its parents supplied it with Rabbits and Hares in such abundance, that its owner obtained a sufficiency of animal food besides for himself and family, "t

When intent on following his game, the Eagle evinces great boldness. On one occasion an Eagle appeared above a pack of hounds, as they came to a fault on the ascent of Devis, the highest of the Belfast mountains, after a good chase. "As they came on the scent again, and were at full cry, the Eagle for a short time kept above them, but at length advanced, and carried off the Hare when at the distance of three to four hundred paces before the hounds. " With similar audacity he dashes down among a "pack" of Grouse, and so "puzzles and confuses the birds, that he seizes and carries off two or three before they know what has happened, and in the very face of the astonished sportsman and his dogs."

It may be observed that the prey is invariably seized with the talons, the beak being used for the purpose of tearing it up. This is contrary to popular belief; and the error deserves to be pointed out, as we find it pervading the descriptions of some of our most gifted poets; as for example, in the magnificent simile employed by Byron: u Even as the Eagle overlooks his prey, And for a moment, poised in middle air, Suspends the motion of his mighty wings, Then swoops, with his unerring beak."

MARINO FALIERO.

Smith's History of Kerry.

f Thompson.

j Idem.

The little assemblages of birds, consisting of the parents and full-fledged young, are indicated by sportsmen by names which differ according to the particular birds spoken of, as a covey of Partridge, a pack of Grouse.

St. John's Wild Sports and Natural History of the Higluands, p. 84.

From the small number of Eagles we possess, compared with that of most other native birds, we consider ourselves fortunate in having, on one occasion, come suddenly upon four Eagles, amid their own wild haunts. It was in September, 1833, when ascending Mangerton mountain, at the Lakes of Killarney, near to the little lake called the " Devil's Punchbowl," we found four of them preying on a full-grown sheep. They rose majestically into the air as we approached. The people who were with us supposed the sheep, being perhaps sickly, had been killed by the Eagles. The flesh of the neck was completely removed, although that of every other part was untouched. We are assured that two Eagles will occasionally pursue a Hare, one flying low, coursing it along the ground, the other keeping perpendicularly above the terrified animal. When the lowest Eagle tires, they change places, and pursue the same system of tactics, until the Hare is completely wearied out. We were told the same circumstance a few days afterwards near Tralee, and again near Monasterevan. Our informant, in every instance, stated the fact as having fallen under his own knowledge, and not as a matter of hearsay.

The nest or eyrie of the Eagle is associated in our minds with highly poetic imagery; but it is regarded in a different light by those who live in the vicinity, and suffer by the predatory habits of its inmates. By them it is viewed as the abode of the spoiler, and the nursery of a future race of aerial tyrants. Various means for its destruction are accordingly resorted to; among others, that of lowering a lighted brand into the nest. This was the plan pursued on one occasion at Roshen, County Donegal: the nest was consumed, three unfortunate Eaglets fell scorched and dead to the ground, - " I was born so high,

Our aiery buildeth on the cedar's top,
And dallies with the wind, and scorns the sun."

KICHARD III. Act i. scene 3.

"The Eagle and the Stork

On cliffs and cedar tops their eyries build."

PARADISE LOST, Book vii.

"When the proud name on which they pinnaced Their hopes is breathed on, jealous as the Eagle Of her high aiery."

MARINO FALIERO, Act v. scene 1.

and the old birds from that time deserted the mountain. A similar mode of destruction has been resorted to at times in other localities; and this, no doubt, suggested to Campbell the splendid description of the burning eyrie, in the Wizard's prophetic warning to Lochiel. f

The true Falcons are distinguished by the upper mandible of the bill being strongly toothed (Fig. 259); by the short, strong legs; the feet with retractile claws of nearly equal size; and the relative proportions of the principal quill-feathers of the wing, the F'. 259 second being the longest. Six species are recorded as British: J we shall

select for description that which is the most celebrated, the Peregrine Falcon (*Falco peregrinus*). It breeds in rocky districts, and has a wide geographical range. In the British Islands it is found in Scotland, in Wales, in Devonshire and Cornwall; and in other localities where there are high rocks adjacent to the coast. In some parts of Ireland it is not uncommon. " In the four maritime counties of Ulster it has many eyries; and in Antrim, whose basaltic precipices are favourable for the purpose, seven at least might be enumerated. " But, notwithstanding its predilection for the coast, this bird frequents occasionally more inland localities; and Sir J. Sebright states, that numbers of them take up their abode at Westminster Abbey,

Thompson.

f We subjoin a portion of the passage referred to: "Ha! laugh'st thou, Lochiel, my vision to scorn? Proud bird of the mountain, thy plume shall be torn! Say, rush'd the bold Eagle exultingly forth, From his home in the dark-rolling clouds of the north? Lo! the death-shot of foemen outspeeding, he rode Companionless, bearing destruction abroad: But down let him stoop from his havoc on high! Ah! home let him speed for the spoiler is nigh. Why flames the far summit? why shoot to the blast Those embers like stars from the firmament cast? 'Tis the fire shower of ruin, all dreadfully driven From his eyrie that beacons the darkness of heaven." They are the Jer Falcon, Peregrine Falcon, the Hobby, the Orange-legged Hobby, the Merlin, and the Kestrel. The last, Mr. Thompson remarks, "is common and resident in Ireland, and is of more frequent occurrence than any of the Falconida. Thompson.

and other churches in the metropolis, and make great havoc among the flocks of tame pigeons in the neighbourhood.

The Peregrine Falcon is the species which, in former times was most used in these countries for the amusement of hawking. This arose from the docility of the bird, and from its being much more numerous, and therefore more easily procured, than the Jer Falcon. " The length of the adult Peregrine Falcon is from fifteen to eighteen inches, depending on the size and age of the bird."t The female bird is of much greater size and strength than the male, and to her, in the language of Falconry, the term "Falcon" was exclusively applied. The male was the "Tiercel," or "Tassel;" the reclaimed male the "Tassel gentle."f The female was flown at Herons or Ducks; the male at Partridges, Magpies, and Rails. The full-grown birds in the wild state, or while unreclaimed, were called " Haggards."

In the training of the Falcons great care, skill, and patience were expended. They were taught to come at the " call," or attend to the " lure " of the keeper. They were carried to the field upon " the fist," a thick, and often a highly ornamented glove being used to prevent the hand from receiving injury from the strength and sharpness of the claws. At such times, their eyes were covered, or "hooded," with a leather covering, usually surmounted by a small ornamental plume of feathers. Bells of brass or silver were attached to the legs; and through small rings likewise fixed there, leathern or silken strings were passed, and wound round the hand of the Falconer

Observations on Hawking.

t Yarrell.

j u Oh, for a falconer's voice to lure this Tassel gentle back again!"

ROMEO AND JULIET. " As coy and wild as Haggards of the rock."

MUCH ADO ABOUT NOTHING.

To this Shakspeare alludes:

"My Falcon now is sharp and passing empty; And, till she stoop, she must not be full gorged, For then she never looks upon her lure. Another way I have to man my Haggard, To make her come, and know her keeper's call."

TAMING OF THE SHREW.

Any one who has read the "Abbot," will remember the quarrel between Roland Grajme and Adam Woodcock, about the feeding of a Hawk. In another of Sir Walter Scott's Tales, "The Betrothed," there is a spirited description of a Hawking-match, in which two Falcons are flown at a Heron.

until the time for ' ' casting off" the bird. When the " quarry" ' was seen, the hood was pulled off, the jesses drawn from their rings, and the Falcon at the same time launched into the air. It tried in all cases to soar above and pounce upon the prey, which it transfixed with its powerful talons.

Old records show the great value which was placed in former times upon these birds, and the high prices at which they were occasionally sold. In several places in the " Domesday Book," ten pounds is made the optional payment instead of finding a Hawk. It is said that in one instance, about two hundred years ago, so much as a thousand pounds were paid for a pair. By the 34th Edward III. it was made felony to steal a Hawk; and to take its eggs, even on a person's own grounds, was punishable with imprisonment for a year and a day, besides a fine at the king's pleasure. Thus prized and protected, and used only by the wealthy and the noble, these birds became the appendage of their state as well as of their pastime.

References to Hawking and its details are of constant occurrence in our old ballads, t Shakspeare, who so invariably " holds the mirror up to nature," hesitates not to introduce the language of Falconry, in giving utterance to the perturbed and distracting meditations of Othello: ' If I do prove her haggard,

Though that her jesses were my dear heart-strings, I'd whistle her off, and let her down the wind To prey at fortune."

The rapid flight of the Falcon is very remarkable. An instance is recorded of one belonging to Henry IV. King of France, which traversed the distance between Fontainebleau and Malta, not less than 1,350 miles, in twenty-four hours. In this case, supposing it to have been on the wing the whole time, its rate of flight must have been nearly sixty miles an hour; but, as Falcons do not fly by night, it was probably not more than sixteen or eighteen hours on the wing, and its rate must, therefore, have been seventy or eighty miles an hour.

The bird flown at by a Hawk was so named.

f Vide The Gay Goshawk, and The Broomfieldhill, in Minstrelsy of the Scottish Border. Sometimes the epithet, "gay Goshawk," is applied figuratively; thus, in the ballad of Pause Foodrage, in the same collection:

"And ye maun learn, my gay Goshawk, Bight weel to breast a steed."

The Peregrine Falcon resembles the Golden Eagle in the indifference evinced occasionally towards sportsmen and dogs. An instance of this is thus narrated by Mr. Thompson: " Mr. Sinclair, when once exercising his dogs on the Belfast mountains, towards the end of July, preparatory to Grouse-shooting, saw them point; and, on

coming up, he startled a male Peregrine Falcon off a Grouse (*Tetrao Scoticus*) just killed by him; and very near the same place my friend came upon the female bird, also on a Grouse. Although the sportsman lifted both the dead birds, the Hawks continued flying about; and on the remainder of the pack, which lay near, being sprung by the dogs, either three or four more Grouse were struck down by them, and thus two and a half or three brace were obtained by means of these wild birds, being more than had ever been procured out of a pack of Grouse by his trained Falcons."

We record, from the same source, another illustrative anecdote: "In October, 1833, a female Peregrine Falcon of Mr. Sinclaire's a bird of that year, and, consequently, but a few months old got loose in the hawk-yard, and killed a male of her own species, a year or two older than herself, and which had the power of moving at least a yard from his block. She had nearly eaten him when a person entered the yard to feed them, which he did once daily, at a regular hour. This female bird was 4 full fed' the day before, and had never got more than one meal in the day."

The Hawks, as distinguished from the true Falcons, have the legs more slender, the wings shorter, the fourth quill the longest, and the middle toe much longer than the lateral ones. There are but two British species,

Fig. 2GO.-Gos, Ji, v., the Gos-hawk (Fig. 260) and the Sparrow-hawk,

The Gos-hawk (*Astur palumbarius*) is equal in size to the largest of the Falcons. Its flight is low, and it was formerly flown at Hares, Rabbits, Grouse, and Partridges. Its prevailing tint is greyish; hence the line in one of the Border Ballads:

"The boy stared wild, like a grey Gos-hawk." FAUSE FOODRAGE.

The Sparrow-hawk (*Accipiter fringittarius*) has been well characterised by Mr. St. John as a "bold little freebooter," 7 and he thus records examples of its audacity: "A Sparrow-hawk pursued a Pigeon through the drawing-room window, and out at the other end of the house through another window, and never slackened his pursuit, notwithstanding the clattering of the broken glass of the two windows they passed through. But the most extraordinary instance of impudence in this bird that I ever met with, was one day finding a large Sparrow-hawk deliberately standing on a very large Pouter-pigeon, on the drawing-room floor, and plucking it, having entered in pursuit of the unfortunate bird through an open window, and killed him in the room." 1

The Kite (*Milvus icinus*, Fig. 261) "is readily distinguished among the British Falconidae, even when at a distance on the wing, by its long and forked tail," and by its easy -, "P J, n- i Fig- 261.-KITE.

and graceful night.

"It has now become comparatively rare in England, "f In Ireland, according to Mr. Thompson, the bird is extremely rare, though the name is applied to other species of the family, and particularly to the Common Buzzard (*Buteo vulgaris*). The Honey Buzzard, a native of the south of Europe, and of eastern climes, has been shot on several occasions in England, and has, in one instance, occurred in the vicinity of Belfast. f The Harriers form the remaining group of "the Falcon family." One of them, the Hen-Harrier, is a most skilful rat-catcher. "Skimming silently and rapidly through a rick-yard, he seizes on any incautious Rat that may be exposed

Wild Sports and Natural History of the Highlands.

f Yarrell.

J Thompson.

to view; and, from the habit this Hawk has of hunting' very late in the evening, many of these vermin fall to his share. Though of so small and light a frame, the Hen-Harrier strikes down a Mallard without difficulty, and the marsh arid swamp are his favourite hunting-grounds. We may here remark, that the whole of the predaceous birds have the power of rejecting from their stomach, in the form of oblong balls, the undigested portions of their food, consisting of bones, hair, and feathers.

111. O W L S. S T R I G I

"The Owl shriek'd at thy birth: an evil sign." SHAKESPEARE.

KING HENRY VI. Part Hi. Act v. scene 6.

The nocturnal birds of prey form the third and last division of the present order, and constitute the well-marked family of the Owls, (Fig. 262). In the dusk of the evening they sally forth, with eyes eminently adapted for the diminished light, and with wings whose movement is so inaudible, that, to use the words of an eloquent writer, "a flake of snow is not winnowed through the air more softly silent." Their strange appearance, grotesque atti-
Fig. 262. o vi. tudes, discordant screams or continuous
Lootings, have made them be regarded by the uneducated as birds of ill omen. f The progress of knowledge dispels these idle fears, and converts a source of terror into one of the countless rills of poetry and tradition.

Owls differ much in dimensions, some even approaching in

St. John's Wild Sports of the Highlands.

f Thus among the prodigies which portended the death of Caesar:

"Yesterday, the bird of night did sit,

Even at noonday, upon the market-place,

Hooting and shrieking." JULIUS C SAE, Act i. scene 3.

size to the Eagles. Among these, the Snowy Owl stands conspicuous; it is a native of high northern latitudes, but has been taken on many occasions in these countries. The species most common in England and Ireland is the White or Barn Owl (*Sirix flammea*). They frequent not barns only, but unoccupied buildings of any kind. The "ivy-mantled tower" is a congenial abode. They leave their retreat about an hour before sunset, to hunt for mice, which form the principal food of themselves and their young; arid in doing so they "beat the fields over like a setting-dog." The numbers of mice destroyed by a breeding pair of Owls must be enormous, and the service they thus perform very great, to the farmer, the planter, and the gardener. "I knew an instance," continues Mr. St. John, t "where, the Owls having been nearly destroyed by the numerous pole-traps placed about the fields for the destruction of them and the hawks, the rats and mice increased to such an extent on the disappearance of these their worst enemies, and committed such havoc among the nursery-gardens, farm buildings, c. that the proprietor was obliged to have all the pole-traps taken down; and the Owls being allowed to increase again, the rats and mice as quickly diminished in number."

Mr. Thompson mentions that a pair of White Owls had their nest and young in a loft appropriated to Pigeons, in the town of Belfast. On the shelf beside the young Owls, the number of dead mice and rats observed remaining after the night's repast, varied from six to fifteen. No attempt was ever made by the Owls to molest either

the Pigeons or their young; and there is strong reason to believe that it is only in the dearth of other prey, that this Owl attacks any of the feathered tribe.

In this particular it differs from the Eagle Owl, a species which inhabits the north of Europe, and has occasionally been taken in these countries. A Swedish gentleman, who lived near a high mountain on which a pair of these birds had built their nest, was witness of the following instance of their affectionate solicitude for their young: One of the young birds, which had quitted the nest, was taken by his servants, and shut up in a hen-coop. " On the following morning, a fine young Partridge was found lying dead before the door of

Natural History of Selborne. f Wild Sports of the Highlands.

the coop. It was immediately concluded that this provision had been brought there by the old Owls, which, no doubt, had been making search in the night-time for their lost young one. And such was, indeed, the fact; for night after night, for fourteen days, was this same mark of attention repeated. The game which the old ones carried to it consisted chiefly of young Partridges, for the most part newly killed, but sometimes a little spoiled." In South America there are Owls which live in burrows excavated by themselves, or by a little quadruped allied to the Rabbit.

ORDER II. INSESSORES. PERCHING BIRDS.

"The ousel-cock, J so black of hue,

With orange-tawny bill: The throstle, with his note so true;

The wren, with little quill; The finch, the sparrow, and the lark;

The plain-song cuckoo grey." SHAKSPEARE.

THE " Perchers," or, to use the scientific term which has the same meaning, the Insectores, are those birds which are not predaceous like the Falcon; which do not scrape the ground like the barn-door fowl; which are not wading birds like the Heron, nor swimming birds like the Duck. The tribe may be thus indicated by a series of negatives; and it embraces a great variety of birds, differing widely in structure and habits. Even within the narrow limits of our islands, above a hundred species belonging to the present order are enumerated.

It is obvious that these birds have no exclusive claim to be regarded as Perchers; for Owls, Eagles, and other birds, perch also. But this habit, taken in connexion with peculiarities of structure, suggests a term which, though not strictly applicable to them alone, is a very convenient one, and not likely to mislead. It naturally suggests a question "How do birds perch?" by what especial contrivance are they enabled to maintain a firm hold even in sleep, at which time, we know, our hands so soon relax in their power of grasping? The

Familiar History of British Birds, vol. i. p. 192. f The Blackbird is sometimes called by this name, and is the species here referred to. Vide Yarrell, note on Ring Ouzel.

mechanism is, at the same time, the most simple and the most effectual. Every one has probably seen the lower part of the leg of a Turkey when cut off, preparatory to the fowl being cooked; and, if so, may have, when a boy, amused himself by pulling the tendons, which, acting upon the claws, enabled him to make them contract or open at pleasure. What he has done by pulling the tendons is done in the perching birds by the tending of the leg, and, by this simple act, the bird, without effort, retains its hold,

and does so securely, even on one leg. The placing of the head under the wing brings the centre of gravity more nearly over the feet, and thus gives additional stability.

From the number of species comprised in the Insectores, it is convenient to divide the order into four groups, which are again subdivided into families, genera, and species. The four groups are established on very obvious characters, connected principally with the form of the beak or of the foot. Some, as for example the Thrush and the Robin, have, on the upper mandible of the bill, a notch or tooth, somewhat similar to that of the Falcons (Fig. 263). These constitute the group of tooth-billed birds; but the man of science, instead of the English term, which would only be understood here, employs a compound Latin term (*Dentirostres*), which means the same thing, and is understood by men of science in every part of the world. The Sparrow has a bill of a different shape (Fig. 264); it is conical. Hence the Sparrow belongs to another group, those with cone-shaped bills (*Conirostres*). The third consists of those birds which are remarkable for their powers of climbing. In them the toes are most usually arranged in pairs, two turned forwards and two backwards, as may be Fig- 264 seen in the foot of the Cuckoo or the Woodpecker (Fig. 272).

It may here be remarked, that the true leg of a bird is the part to which that name is given when a fowl is brought to table. The part called the leg in the living bird lies between the leg, properly so called, and the foot, and is analogous to that part of our foot which lies between the ankle and the toes.

f Latin *Dens*, a tooth 5 rostrum, a beak.

The term applied to the group is that of *Scansores* or climbers. The fourth is composed of those birds whose beaks are so wide and gaping that it appears as if cleft, hence they are named *Fissirostres*. The Swallow or Swift, in chase of their insect prey, are familiar examples of this structure. A much maligned bird, that also feeds upon insects, exhibits this peculiarity. We allude to the Goatsucker (*Caprimulgus Europceus*, Fig. 265), which popular credulity has accused in Italy of sucking goats, and here of sucking cows, and inflicting a fatal distemper upon weaning calves. We have thus four tribes of perching birds: I. Tooth-billed, *Dentirostres*.

II. Conical-billed, *Conirostres*.

III. Climbers, *Scansores*.

IV. Gaping-billed, *Fissirostres*.

We shall now notice some well-known individuals of each of these tribes, though necessarily with great brevity, devoting our space principally to those which are natives, in preference to the more brilliant inhabitants of foreign climes.

TRIBE I TOOTH-BILLED BIRDS. *DENTIROSTRES*.

"Brisk Robin seeks a kindlier home; Not like a beggar is he come, But enters as a looked-for guest, Confiding in his ruddy breast, As if it were a natural shield Charged with a blazon on the field, Due to that good and pious deed, Of which we in the ballad read." WORDSWORTH.

Laniidae The Shrikes or Butcher-birds bear some resemblance in habit, and in the curved projection of the upper part of the bill, to the birds of prey. "The Grey Shrike," says Mr. Yarrell, "feeds upon mice, shrews, small birds, frogs, lizards, and large

insects; after having killed its prey, it fixes the body on a forked branch, or upon a sharp thorn, the more Latin *Lanius*, a butcher.

readily to tear off small pieces from it. It is from this habit of killing and hanging up their meat, which is observed also in other Shrikes, that they have been generally called Butcherbirds. They are not plentiful in these countries.

Passing by the Fly-catchers (*Muscicapidae*), of which there are only two native species, we come to that of the Thrushes (*Merulidae*). To this family belongs the Water Ouzel (*Gin-clus aquaticus*), a bird which frequents rocky streams, and the banks of rapid rivers in mountainous districts. "With the romantic and picturesque in scenery," says Mr. Thompson, "this bird is associated, frequenting the stream only so far as it can boast of such charming accompaniments; whenever it descends to the lowlands to move sluggishly through the plain, the Water Ouzel forsakes it, to continue in its upland haunts."

A question has arisen in reference to the habits of this bird, whether it can or cannot walk underneath the water. Mr. St. John, the latest writer upon the question expressly states, in opposition to Mr. Waterton, that on two or three occasions he has seen the Water Ouzel walk deliberately down into the water, and run about on the gravel at the bottom, scratching with his feet among the small stones, and picking away at all the small insects and animacules which he could dislodge.

The Missel Thrush (*Turdus visdvorus*) is in England considered only as an early songster, but in Ireland its song may be heard at every season of the year, with the exception of the moulting season. That of the Fieldfare, a migrating Thrush that arrives from the north towards the end of October, and remains in these countries in large flocks during the winter, is described as soft and melodious. But the present genus contains two species, which bear away the prize in minstrelsy from any of their associates the Song Thrush (*Turdus musicus*, and the Blackbird (*T. merula*), "the Mavis and Merle" of the Border Ballads. The poet has, in one line, characterised both the song and the haunts of the one last mentioned:

"The Blackbird whistles from the thorny brake."

THOMSON'S SEASONS.

The Thrush usually haunts woods and small plantations, but we have heard its song poured out on one of the wildest mountain tracts in the County of Antrim, the singer being

Wild Sports of the Highlands.

perched upon a ragweed. Mr. Thompson records an instance in which one of these "birds built five nests in the course of one season, and reared seventeen young. We have already adverted (p. 181) to the tantalising proof we experienced of its partiality for one of our most beautiful land shells, or rather for its occupant, as food.

Sylviadce. The family we have next to mention is the most musical in Europe, and some of its members have attained the highest reputation as vocalists. Among those best known may be mentioned the Redbreast, Sedge-Warbler, Nightingale, Blackcap Warbler, and Willow Wren. The brief notice we can give shall be bestowed upon the Redbreast and the Nightingale.

We have been taught to love the Robin Redbreast (*Sylvia rubecula*), associated as it is with recollections which the wear and tear of after life can never efface. Those who

have lived in this country have seen him during the summer feeding on earth-worms, caterpillars, berries, and fruits; and in winter presenting himself to receive from the hand of man the food which the frozen earth withholds. His habits, when he first ventures into the cottage to pick up the proffered crumbs, have been truly described by Thomson:

"Then hopping o'er the floor,
Eyes all the smiling family askance,
And pecks, and starts, and wonders where he is."

"The sprightly air of this species," says Mr. Yarrell, "the full dark eye, and the sidelong turn of the head, give an appearance of sagacity and inquiry to their character, which aided by their confidence has gained them friends; and the Robin has accordingly acquired some familiar domestic name, in almost every country of Europe."

The bird seems at times to have indulged in some whimsical fancies as to the situation of his nest. "A pair took up their abode in the parish church of Hampton, in Warwickshire, and affixed their nest to the church Bible, as it lay on the reading-desk. The vicar would not allow the birds to be disturbed, and

Shakspeare mentions the bird by the old Saxon name the Ruddock, and refers to its performance of the same office as that attributed to it in the well-known ballad:-

"The Ruddock would,
With charitable bill, bring thee all this,
Yea, and furred moss besides, when flowers are none,
To winter-ground thy corse." CYMEKLINE, Act iv. scene 2.

therefore supplied himself with another Bible, from which he read the lessons of the service." One pair built repeatedly adjoining a blacksmith's shop; but neither the noise of the adjacent forge, nor frequent visits disturbed them. t Another constructed the nest in a hole in the timbers of a vessel undergoing repairs in the dry dock at Belfast, while the deafening process of driving in what are called the tree-nails was carried forward, occasionally close to the nest. J But a more extraordinary selection was made by one which had been frequently expelled from a bird-stuffing room, where the window was kept open, and is thus recorded by Mr. Thompson: "Finding that expulsion was of no avail, recourse was had to a novel and rather comical expedient. My friend had, a short time before, received a collection of stuffed Asiatic quadrupeds, and of these he selected the most fierce looking Carnivora, and placed them at the open window, which they nearly filled up, hoping that their formidable aspect might deter the bird from future ingress; but the Redbreast was not to be so frightened from its propriety," and made its entree as usual. Its perseverance was at length rewarded by a free permission to have its own way, when, as if in defiance of the ruse that had been attempted to be practised upon it, the chosen place for the nest was the head of a Shark!"

The Nightingale (*Sylvia luscini*a) stands pre-eminent in all the requisites for first-rate song. The volume, quality, and execution of its voice are unrivalled among British birds, and its powers appear still more extraordinary, taken in connexion with the diminutive size of the musician. It is a native of southern climes, and appears in England in April, the arrival of the males preceding that of the females from ten to

fourteen days. It is by no means generally distributed. It does not appear to frequent Cornwall nor Wales, and is rarely heard to the north of Warwickshire; it is consequently absent from Scotland and the adjoining islands; and is altogether unknown in Ireland.

From the pleasing little volumes to which we have more than once referred, the *Familiar History of Birds*, by the Bishop of Norwich, vol. ii. p. 35. The fact is given on the authority of a writer in *Magazine of Natural History*, No. 31.

f Yarrell, from the *Field Naturalists' Magazine*.

Thompson. The vessel was the Dunlop.

Yarrell.

The song of woe, which the poets have attributed to the Nightingale is entirely fanciful. To the solitary and sentimental muser, the notes may have seemed plaintive in the extreme, and suggested the idea of the widowed bird mourning for her mate. But the songs of birds are not the vehicle of sorrow, but the expression of joy; and in most cases they proceed from the male bird, either while wooing his partner, or cheering her in the performance of her maternal duties. The song of the Nightingale is the outpouring of joy, and not of sadness, and is due mainly, if not exclusively, to the male.

The beautiful golden-crested Wren (*S. regulus*, the various species of Titmice (Paras), the vivacious and attractive Wagtails (*Motacilla*), can only be mentioned. To them succeed the Pipits (*Anthus*) frequenting the wood, the meadow, or the coast, according to the different habits and food of the several species. They lead by easy stages to the True Larks, which commence the next group those which have the bills conical.

Fig. 266. HUMMING-BIRD.

Before, however, giving attention to them, we would like to pause for a moment on tropical birds remarkable for their slender bills, and hence spoken of by some writers by a term denoting this peculiarity (*Tenuirostres*). They cannot be better exemplified than by the Humming-birds (Fig. 266), a "Here can I sit alone, unseen of any,

And to the Nightingale's complaining notes Tune my distresses and record my woes."

Two GENTLEMEN OF VEUOXA, Act v. scene 4.

tribe which includes some of the smallest and most beautiful of the whole feathered race, combining the richness of flowers and the brilliancy of gems. They take their name from the manner in which they hover over flowers, keeping up a humming noise by the vibration of their wings, the motion of which at such times is so rapid as to be scarcely visible. Mr. Darwin says they reminded him of the sphinx moths, and considers that insects rather than honey are the objects of their search an opinion which an examination of the stomachs of several specimens which were shot confirmed, as the remains of insects were found in all.

TRIBE II. CONICAL-BILLED BIRDS. CONIROSTRES.

' The Daw,

The Rook and Magpie, to the grey-grown oaks direct their lazy flight."

SUMMER.

THE first bird we shall mention the Sky-lark does not exhibit that form of bill which gives name to the tribe; the true representatives of the group must be sought, not upon

the outskirts, but towards the centre of the territory. The hinder toe is apparently disproportioned to the others by its great length; but this peculiarity, which unfits the Lark for perching, enables it to walk with ease upon the grass, and spring upwards ere the wings are expanded for flight. The food consists of seeds, worms, and insects. The bird delights in dusting itself; a process in this as in others resorted to, for the purpose, it is supposed, of freeing themselves from small parasitic insects. In autumn, Larks collect in large flocks, become fat, and in some parts of England are captured by nets in large numbers, and sold as a delicacy.

But it is not any one of these circumstances, nor all of them together, that gives the Lark its fascinations when in early spring we listen to the flood of music it pours on the

Journal, pages 37, 330. G2 awakening earth, or hearken to the cheerful influence of its song as described by Milton:

"To hear the Lark begin his flight, And singing startle the dull night; From his watch-tower in the skies, 'Till the dappled morn doth rise, Then to come in spite of sorrow, And at my window bid good-morrow."

L'Al. LEGRO.

Calculations as to the usefulness of the bird are lost sight of; and apart from them altogether, men by universal consent, pay homage to the joy-inspiring minstrel, whose note is ever fresh and ever gladsome. By Thomson he is described as, - "The messenger of morn,

Ere yet the shadows fly, he mounted sings Amid the dawning clouds, and from their haunts Calls up the tuneful nations." SPRING.

The Lark is universally distributed over Europe, and descriptions akin to these are everywhere current. Who then could wish that the Zoologist and the Poet should move in separate paths? Who would not desire that the Poet should proclaim the truths which the objects around him teach, and lead man to regard them as volumes which the Creator has unfolded for his perusal?

Fringillidæ. Associated with the Larks in one extensive family containing nearly thirty native species, are the Buntings, the Finches, Sparrows, Grosbeaks, and some who as songsters are justly prized, as the Goldfinch, the Linnet, and the Bullfinch; also the singular Crossbill whose beak would seem deformed and useless, did not a knowledge of the manner in which it is employed in opening the cones of the fir-tree, show that it is in reality a most efficient instrument for its destined purpose.

Sturnidæ. The common Starling (*Sturnus vulgaris* Fig. 267) is the representative of another family. It is well known for its power of imitating sounds; and from an early age has in our minds been associated with Sterne's well known words,

Latin Fringilla, a Chaffinch.

t This figure, and that of the Gull (284) are copied from Bewick,

"I cannot get out;" and with the angry resolution of Hotspur, t

The Starling is a migratory species; but a difference of opinion prevails among naturalists as to the extent and regularity of the migration. The most recent record on the subject is that afforded by Mr. W. Thompson, J relative to the appearance of the Starling in the neighbourhood of Belfast. He informs us that this occurs towards the middle or latter

Fig. 267. STARLING.

end of September, and continues for about six or eight weeks: that the flocks are seen every fine morning coming from the north-east, and continuing the same course: and that each flock consists of from half-a-dozen to two hundred individuals, and arrives generally between eight and ten o'clock. " At the season of their earliest appearance there is daylight between four and five o'clock in the morning, and their not being seen before eight o'clock, leads to the belief that they have

"The Captive."

f " I'll have a Starling shall be taught to speak Nothing but Mortimer."

KING HENRY IV. Part i. Act i. scene 3. f Annals and Magazine of Natural History.

left some distant place at an early hour." The greatest number ever seen in one day in their course of flight, amounted to 1,500; and the entire number thus seen during the migratory period, to about 15,000.

Mr. Yarrell mentions localities in which these birds congregate by thousands; in one case in the vicinity of Bristol, by millions. Their food consists of worms, insects, snails, berries, and grain. They build in ruins, old trees, church-steeple, rocks, and holes about buildings; and Mr. Ball has remarked, that the celebrated round towers of Ireland are favourite nesting-places. The evolutions of a large body of Starlings before retiring to rest have been so graphically described in the "Familiar History of Birds," that it would be doing injustice to the learned and right reverend author, not to give the words there employed.

"At first they might be seen advancing high in the air, like a dark cloud, which in an instant, as if by magic, became almost invisible, the whole body by some mysterious watchword or signal changing their course, and presenting their wings to view edgewise, instead of exposing, as before, their full expanded spread. Again, in another moment, the cloud might be seen descending in a graceful sweep, so as almost to brush the earth as they glanced along. Then once more they were seen spiring in wide circles on high, till at length with one simultaneous rush down they glide, with a roaring noise of wing till its vast mass buried itself unseen, but not unheard, amid a bed of reeds projecting from the bank, adjacent to the wood. For no sooner were they perched than every throat seemed to open itself, forming one incessant confusion of tongues."

This is perhaps the place where reference may be made to the Birds of Paradise (Fig. 268), which according to eastern fable, lived upon dew and vapour, and carried on without

Fig. 268 BIRD Off PAR ARISE.

descending to earth all the functions of life, even to the production of their eggs and young. They have justly been said, from the extreme beauty of their plumage, to hold the highest rank among the feathered glories of the creation. They are limited to New Guinea, or as it is frequently called, the country of the Papuas, and some of the adjacent islands of the South Pacific Ocean. The natives of these countries, when preparing and drying the skins, were in the habit of removing the feet of the bird. The skins in this state were sold to the Malays, carried into India, and thence conveyed into Europe. Here we have the origin of the superstitious ideas with which

these birds were formerly associated, arising from the supposed want of legs. The legend has been commemorated by Linnaeus, who applied to the best known species the appellation, "footless;" and it has been enshrined in the harmonious lines of the poet: – "The footless fowl of heaven that never Eest upon earth, but on the wing for ever, Hovering o'er flowers their fragrant food inhale,

Drink the descending dew upon its way, And sleep aloft while floating on the gale."

SOUTHEY'S CURSE OF KEIYAMA.

Corvidoe. The Starling which has been already noticed, and the Raven, the Magpie, and the Jay, which are members of the present family, possess the power of imitating the human voice in a higher degree of perfection than any other British birds. One example of this has been mentioned in a preceding page (p. 323).

The Raven labours under the misfortune of being regarded as a bird of ill omen. f High rocks and other places where danger may best be descried are his favourite haunts. His food is various, emmets, reptiles, birds and their eggs, fish and carrion; like other species he is partial to chickens and young ducks; and we were assured on one occasion by a credible witness that he had seen a raven alight among a flock of full-

Paradisea apoda.

The Raven himself is hoarse

That croaks the fatal entrance of Duncan Under my battlements." MACBETH.

"Oh, it comes o'er my memory,

As doth the Raven o'er the infected house, Boding to all!" OTHELLO.

grown ducks, give one of them a few blows, throw it on its back, and forthwith begin to tear it np. Such audacity is of extremely rare occurrence.

It is pleasant to think of birds in connexion with the localities in which they were observed. Our rambles along the shore of the County Antrim, have given us frequent opportunities of noticing the Hooded-crows (*Corvus comix* upon the beach: they were not usually in pairs; three were more frequently seen than two, and five than four. There too, near the basaltic headlands of that noble coast, we have gazed with pleasure on the Chough (*Fregilus gracuhis*), as it sailed above our head, the brilliant red of its legs contrasting beautifully with the glossy bluish black of the plumage.

There is, however, no bird of the family so well known throughout all the cultivated parts of the kingdom as the Rook (*Corvtia frugilegus*), and as we prefer dwelling on that which is common, rather than on that which is rare, we devote to its habits the space at our command.

It is a social bird, fond of living about the abodes of man, and even of building in the heart of crowded cities. But it is not with such haunts that its appearance is usually associated, but with time-honoured mansions, and more especially lofty trees, their chosen abodes during successive generations.

Washington Irving has written respecting these birds, in his usual agreeable style. "They are," he says, "old established housekeepers, high-minded gentlefolk, that have had their hereditary abodes time out of mind;" and he goes on in the same amusing manner to describe, what "rather derogates from the grave and honourable character of these ancient gentlefolk, that during the architectural season, they are subject to great dissensions among themselves; that they make no scruple to defraud and plunder

each other, and that sometimes the rookery is a scene of hideous brawl and commotion, in consequence of some delinquency of the kind."

Mr. Macgillivray, when visiting a rookery at night, "was surprised to hear several rooks uttering a variety of soft clear modulated notes very unlike their usual cry. In the interval I could distinguish," says he, "the faint shrill voice of the newly hatched young, which their mothers, I feel persuaded, were fondling and coaxing in this manner. Indeed the sounds

The Rookery, Bracebridge Hall, t British Birds, vol. i. p. 549.

were plainly expressive of affection, and a desire to please." The young who are the objects of this solicitude suffer greatly in seasons of drought. Mr. Knapp mentions that, in the hot summer of 1825, many perished from want; the mornings were without dew, few or no worms could be obtained, and all the young were found dead under the trees, having expired on their roostings.

The supply of food involves a question of much importance to the farmer; namely, whether Rooks do him most good or most evil? If it were possible to keep a regular account of all their proceedings and their results, which way would the balance lie? Should he regard the Rooks as friends or as enemies? The question when considered for a moment expands, and presents itself under a new form, and comprises not Rooks alone, but all those "trooping birds" that live partly upon insects, and partly upon grain and other produce.

The opinion of those who have most attentively weighed the evidence on both sides is, that the continual benefit which Rooks confer by the destruction of snails, worms, and insects in their several states, far more than compensates for the occasional injury they inflict. It is needful at seed-time to guard the newly sown grain, and the potato "sets" against their depredations; that being done, offer them no molestation. There are numerous insects that, in the Caterpillar state, eat away the roots of grain or grass crops, while others in different stages make their attacks above ground, and at a later season. The larvae of the Cockchafer,¹ of the Click Beetles, and of the Harry-longlegs, are all underground feeders; and sometimes when Rooks pull up grass and scatter it about, its roots have been already destroyed by the unseen devastators for which the birds are searching. "A gentleman," says Mr. Jesse, "once showed me a field which had all the appearance of being scorched as if by a burning sun in dry hot weather. The turf peeled from the ground as if it had been cut with a turfing-spade, and we then discovered that the roots of the grass had been eaten away by the larvae of the Cockchafer, which were found in countless numbers at various depths in the soil." The Rooks, which evince

Journal of a Naturalist. Tipulidæ.

f Melolontha vulgarly. Gleanings of Natural History.

f Elaterida³.

remarkable quickness in detecting such spots, were in reality benefactors, not destroyers. Numerous other examples of a similar kind might be brought forward. To these might be added others no less instructive, in which the Rooks in certain districts having been extirpated, so great an increase of the insect enemies of the agriculturist took place, that the crops, for two or three successive seasons, were utterly destroyed,

and the farmers obliged at some trouble and expense to reinstate the Rooks in order to save their crops.

In 1831 or 32 we noticed great quantities of the skulls and other bones of Rooks lying on the shores of Lough Neagh, and understood that during a dense fog multitudes of these birds had perished in the waters, and that their bodies had afterwards been drifted ashore. After the great hurricane of the 7th of January, 1839, many thousands were picked up dead on the shores of a lake some miles in length, in the County of Westmeath, with extensive rookeries on its borders.

The wary Magpie, the busy Jackdaw, and the cheerful Jay a bird unknown in the northern parts of Ireland all belong to the present family; and various are the petty larcenies which have been laid to their charge. One of the most perplexing occurred at Cambridge, where the Daws took a Fig. 269.-Hornbill. fancy to employ, in the construction of their nests, the wooden labels used in the Botanic Garden for the names of seeds and plants; and to such an extent did they avail themselves of these materials, that so many as eighteen

This singular fact was communicated to Mr. R. Ball, of Dublin, by Dean Vignolles, on whose property it occurred.

dozen of labels were found in the shaft of a single chimney in which these birds were in the habit of building.

There are some foreign birds which, in their general habits, approach to the present family. They are remarkable for the excrescence by which the beak is surmounted, and from which they derive their name of Hornbills (Fig. 269). This singular appendage is extremely light, consisting of numerous cells filled with air, which in fact penetrates with great facility every part of their skeleton. The African species are described as living on small Birds, Mice, Reptiles, and even carrion, and only descending to vegetable diet when better fare is not attainable. The Asiatic species seem more restricted to fruits, and in the Molucca islands live chiefly upon nutmegs. In the great size of the beak, and in the habit of swallowing their food whole, the Hornbills bear a resemblance to the Toucans, a family of climbing birds which inhabit the thick forests of tropical America, and whose principal food is the eggs and the young of birds.

TRIBE III. CLIMBING BIRDS.- SCANSORES.

; ' In gaudy robes of many coloured patches, The Parrots swung like blossoms on the trees, While their harsh voices undeceived the ear."

MONTGOMERY'S " PELICAN ISLAND."

WE cannot give better examples of the climbing birds than those furnished by the Parrots, Cockatoos, and Macaws (Fig. 270) of tropical countries; those beautiful birds, many of which are domesticated in our houses, and which are uniformly one of the principal points of attraction in our Zoological gardens. The formation of the foot and of the beak qualify them in a pre-eminent degree to act as climbing birds.

The Woodpeckers, among British birds, belong to the present group. Their food consists of insects in different states, for which they search under the bark of trees, digging into

Stated by Mr. Yarrell and by Mr. Jenyns, on the authority of Mr. Denson.

the wood of such as are decayed. The point of the tongue is furnished with hairs pointing backwards (Fig. 271), and the tongue has a peculiar and very effectual

apparatus by means of which it is launched at the insect prey. The tail, in conjunction with the two feet, acts as a tripod (Fig. 272), and gives the bird the requisite stability while proceeding with its operations.

A favourite bird, remarkable both for its diminutive size and for its large family, must not be unnoticed. We allude to the Wren (*Troglodytes Europæus*). It comes about our dwellings almost with the confidence of the Robin, and like that bird, has in its favour, the potent recommendation which clings to the stories and lays of childhood. Fig. 270. MACAW. But perhaps there is no individual bird whatever whose habits are so peculiar as those of the Cuckoo (*Cuculus canonicus*), and none whose cheerful note in the spring-awakens more gladsome feelings. It builds no nest, but drops

Tongue

Fig. 271. SKULL OF WOODPECKER.

its eggs into the nests of other birds; one only is supposed to be dropped by the same Cuckoo into the same nest. The nests principally selected are those of the Hedge Sparrow, the Pied Wagtail, and the Meadow Pipit. The young Cuckoo, soon after it has been hatched, throws out of the nest the other young birds, and also the eggs, remaining sole occupant of the place, and securing to its own use the food which the old birds supply. This habit is the more remarkable in our common Cuckoo, as the American Yellow-billed Cuckoo, which has been occasionally taken in these countries, builds a nest and rears up the young in the ordinary way.

Poets have delighted in offering to the Cuckoo as herald of the spring their melodious tribute. Wordsworth refers to the well-known call of the male when the bird itself is concealed:

Fig. 272. WOODPECKER.

"Thrice welcome, darling of the spring;

Even yet thou art to me No bird, but an invisible thing A voice, a mystery."

Its cheerful note, and the verdure with which in our minds it is associated, are alluded to, no less happily, by another writer:

"Sweet bird! thy bower is ever green,

Thy sky is ever clear; Thou hast no sorrow in thy song, No winter in thy year."
LOGAN.

"This guest of summer The temple-haunting Martlet, does approve, L? y his loved mansionry, that the heaven's breath Smells woovingly here; no jutting, frieze, buttress, Nor coigne of vantage, but this bird hath made His pendant bed, and procreant cradle: where they Most breed and haunt, I have observed the air Is delicate." SHAKSPEARE.

THE first family of the present group consists of the Bee Eaters (*Meropida*) birds of bright plumage, natives of Africa and of Asia Minor, which, as occasional visitors, are ranked among British species. Next to "them the Kingfishers (*Halcyonidae*, Fig. 273), claim our attention. There is but one native species (*Alcedo ispida*), and in point of brilliant plumage, it is unquestionably the first of British birds, and not surpassed by many of those belonging to tropical countries. It chooses for the site of its nest some spot in the overhanging bank of a stream, and lives upon small fish and aquatic insects. Kingfishers, like many other birds, possess the power of reproducing the contents of the stomach at pleasure. This is of service at times in feeding the young, and on other

occasions in discharging, as in the case of birds of prey, the indigestible portions of the food.

It was formerly believed that the Kingfisher, or as it was then termed, the Halcyon, hatched her eggs in a floating nest, and that, during the time she was thus engaged, the winds

Yarrell's British Birds, vol. ii. to which the reader is referred for information, drawn from various sources, respecting the fabled Halcyon.

Fig. 273. KINGFISHER.

were at rest, and the sea remained smooth and calm. This period was therefore called by Pliny and Aristotle the Halcyon days, and as such is frequently mentioned or referred to by the poets. Thus

"All nature seemed

Fond of tranquillity; the glassy sea

Scarce rippled the Halcyon slept upon the wave;

The winds were all at rest." THE STORM.

The Goatsuckers (Caprimulgidae), to whose habits reference has already been made (p. 344), form another family of this tribe. Though abundant in certain situations they are not generally diffused; and about Belfast their occurrence is so very rare that we have never seen one alive. We shall therefore devote all our available space to the remaining family, that of the Swallows (Hirundinidae).

"The Swallow," says Sir Humphrey Davy, in his *Salmonia*, " is one of my favourite birds, and a rival of the Nightingale, for he cheers my sense of seeing as much as the other does my sense of hearing. He is the glad prophet of the year the harbinger of the best season; he lives a life of enjoyment amongst the loveliest forms of nature; winter is unknown to him; and he leaves the green meadows of England in autumn for the myrtle and orange groves of Italy, and for the palms of Africa." The bird does not winter in Italy; but in other respects, " this is, in truth," to use the words of Mr. Yarrell, " a brief but a perfect sketch of the history of the Swallow."

The Swallow (*Hirundo rustica*) arrives in these countries about the 10th of April, and remains about six months. It builds in the shafts of unused chimneys, and under the shelter afforded by the roofs of out-houses, preferring such situations as are in the vicinity of water, and where its insect prey may be regarded as most abundant. The chestnut and blue of the breast, the black legs and toes, and the larger size distinguish it from the species next to be mentioned.

The House-martin, (*H. urbana*). In this bird the chin and all the under part of the body is white, and the legs covered with short downy white feathers. It appears a few days later than the Swallow. It is this species which the poet has so beautifully pictured (p. 360); and whose nest every

"Swallows leaving Italy, which they all do in autumn, go off in the direction of Egypt, and have been seen in Egypt going still farther south." Yarrell, vol. ii.

one has seen fixed under the eaves of houses, and the upper angles of windows. They are sometimes placed under the arch of a bridge, and the magnificent head-lands of basalt, on the county of Antrim coast, are favourite haunts.

The House-martins return to their old abodes. Mr. Thompson records an instance in the neighbourhood of Belfast, in which a pair found their nest occupied by a

Sparrow, who seemed determined to keep possession. The Martins departed, returned with about twenty of their kindred, and built up the entrance to the nest, inclosing the offender within. Next morning the pair of Martins commenced the construction of a new nest, against the side of their old one, and in it, undisturbed, reared their brood. After some time the proprietor of the cottage had the curiosity to pull down both nests, and in that occupied by the Sparrow found its "rotten corpse," together with several eggs. Mr. Thompson suggests that the Sparrow allowing herself to be entombed alive, may probably be explained on the supposition that the eggs were in the last state of incubation, as at such times birds will occasionally allow themselves to be lifted in the hand, and when placed again continue to sit as intent upon their hatching as if they had not been disturbed.

The Sand-martin or Bank-martin (*H. riparia*) is smaller in size than either of those mentioned, and is the earliest to arrive in these countries. It has been seen in the neighbourhood of Belfast on the 29th of March. It forms excavations in sand-banks, and in these constructs its nest; from this habit the name is derived.

The Common Swift (*Cypselus murarius*) is distinguished by its greater expanse of wing, its darker colour, and by having all the four claws of its foot pointing forward, instead of three forward and one backward, as in the Swallow and the Martins. It prefers for its building-sites lofty towers and church steeples, but when these are not to be had, it very wisely contents itself with more lowly stations, such as the eaves or thatch of dwelling-houses. It also frequents the romantic precipices which are resorted to by the Martin, t It usually arrives the first week in May, and departs in August, though an occasional straggler may be seen after that period.

Mag. Annals of Natural History, vol. x. p. 50. References are there given to other notices of similar events. f Thompson.

' The careful Hen

Calls all her chirping family around, Fed and defended by the fearless Cock, Whose breast with ardour flames, as on he walks Graceful, and crows defiance." SPUING.

THE present order includes the common Barn-door Fowl, such as the Cocks, Hens, Pea-fowl, and Turkeys; also the different kinds of Pigeons, Pheasants, Grouse, and Partridge. They are not in general adapted for rapid flight. They have the body hulk, the wings short, the legs robust, and the feet formed for walking; the feet are also employed in scratching the ground, and thus exposing to view the seeds or other food on which the birds subsist. This action is one of such constant occurrence in the Domestic Hen, that it cannot have escaped the notice of the most careless observer. It is this habit of scraping or scratching the ground, that gives the name to the order, the Latin word *rasores* literally signifying "scrapers." Passing by those which are living in a domesticated state, the species known as native in these countries may be arranged in four families Doves, Pheasants, Grouse, and Bustards.

Columbidae. To this family belongs the Ring-dove, or Wood-pigeon (*Colubris palumbus*) it is the Cushat of the poets, and the Wood-quest of the North of Ireland. This species frequents woods, and in certain situations is so numerous that many hundreds may be seen in a single flock. Great are the complaints made by farmers of the injury they sustain by the quantity of grain consumed by these birds; and some who have advocated the utility of the Rooks have felt unable to do the same with regard

to Wood-pigeons. Not so, however, Mr. St. John. An agricultural friend called his attention on the 6th of March, to an immense flock of these birds busily at work on a field of young clover, which had been under barley the last season, "On this," says he, "in furtherance of my favourite axiom, that every wild animal is of some service to us, I determined to shoot some of the Wood-pigeons, that I might see what they actually were feeding on; for I did not at all fall into my friend's idea that they were grazing on his clover." Eight were accordingly shot as they flew over his head. On being opened, "every Pigeon's crop was as full as it could possibly be of the seeds of two of the worst weeds in the country, the wild mustard and the ragweed, which they had found remaining on the surface of the ground, these plants ripening and dropping their seeds before the corn is cut. Now, no amount of human labour and search could have collected, on the same ground, at that time of the year, as much of these seeds as was consumed by each of these five or six hundred Wood-pigeons daily, for two or three weeks together."

The Rock-dove (*C. livid*) builds in rocky cliffs and caverns, most usually in the vicinity of the sea, but occasionally inland. It is the species from which the varieties of the domestic Pigeon are derived. We cannot here detail the means by which these are preserved and perpetuated; we prefer limiting our brief notice to one of these varieties, the Carrier-pigeon, a bird whose services have been made available not in love affairs only, but in those of the turf, the mart, the exchange, and the cabinet; in all the deep stakes which are won and lost in the chequered pursuits of human life.

From the rapidity and general certainty with which the letter entrusted to the Carrier-pigeon is conveyed, it would seem at first sight as though the bird were guided by some mysterious instinct; but our wonder is diminished when we are aware of the care and pains bestowed upon the training of these Pigeons. They soon learn, in their daily excursions with the old birds, to know their own abode, and to distinguish it from all others. They are then brought a short distance from home in a covered basket, and let loose. The distance is increased, until two, four, eight, ten, or twenty miles are gradually attained; and this is continued until the entire distance they are expected to perform has become familiar to them. When first let loose, the flight is spiral; when a sufficient elevation has been gained, and some well-known object descried, the bird goes off in a direct and unwavering line of flight.

Wild Sports of the Highlands, p. 119.

If no unfavourable circumstances occur, such as fog, mist, or a strong opposing wind, the speed with which the journey is accomplished is very remarkable. Of this many well-authenticated instances are recorded. On one occasion a Carrier-pigeon flew from Rouen to Ghent, a distance of about 150 miles, in an hour and a half. On another, 23 Irish miles were accomplished in eleven minutes; or, in other words, at the rate of 125-J miles an hour. f

The Turtle-dove (*C. turtur*) is a summer visitant, but by no means widely or plentifully diffused. The Passenger-pigeon (*C. migratoria*) is included, like other stragglers, in the list of British birds. It is a native of America, and ranges over the whole of the vast continent lying between the Rocky Mountains and the Atlantic. To the works of Wilson, Audubon, and other writers, we must refer for an account of its habits. We can but notice the amazing numbers in which it sometimes appears,

and the quantity of food required for the daily sustenance of one of these immense flocks. Estimating its breadth at one mile, which is below the average, and allowing two Pigeons to each square yard, the number in one flock, according to Audubon, would be 1,115,000,000; and, as every Pigeon consumes daily half a pint of grain, the quantity required to feed such a flock must amount to 8,712,000 bushels per day. J

Phasianidæ. The Common Pheasant (*Phasianus Col-cliius*) represents another family. This beautiful bird has been long naturalised in these countries, but came originally from the banks of the Phasis, a river in Colchis, in Asia Minor. The Grouse belongs to another family (Tetraonidæ); one of these, the Red Grouse (*Tetrao Scoticus*), is peculiar to the British Islands, being unknown in any other part of the world. It inhabits wild extensive heaths, whether moor or mountain, and in some districts of both Scotland and Ireland is very abundant. The Black Grouse is found in both England and Scotland, but not in Ireland. This bird has been known to pair with the Pheasant in a wild state, the hybrids thus produced exhibiting some of the characters of

Yarrel.

t Thompson.

j Audubon's calculation is founded on the supposition that the flock, moving at the rate of one mile per minute, takes three hours to pass by a given spot; thus forming a parallelogram of 180 miles long by 1 broad.

VOL. II. II both species. The White Grouse, or Ptarmigan (*Lagopus mutus*, Fig. 274), is only found on some of the high mountains of Scotland and the adjacent islands. It is celebrated for its change of colour. The legs and toes are so thickly covered with woolly feathers, that they have been compared to the legs of a Hare. In summer the plumage is speckled, consisting of an ashy brown, with waving blackish lines; as winter approaches, this becomes changed to the purest white. In the one season the plumage resembles in colour that of the surrounding rocks and lichens; in winter, that of the snow-clad mountains. Sir Walter Scott attributes, therefore, acute powers of vision to Malcolm Grubine, when he says

"Trained to the chase, his Eagle eye The Ptarmigan in snow could spy."

LADY OF THE LAKE.

The Common Partridge (*Perdix cinerea*) is another member of the same family; so that in this one group we have an assemblage of birds possessed of peculiar attractions to the "sportsman."

To the Quail (*Perdix coturnix*) a different kind of interest attaches. This bird is believed to be identical in species with that which, under the providence of God, furnished a supply of food to the Israelites in the wilderness. It abounds in countries adjacent to the Red Sea, and migrates in immense multitudes. Temminck says that they arrive in such numbers on the western shores of the kingdom of Naples, that so many as 100,000 are taken in a day. Nor are they less numerous on the shores of Provence. Above three thousand years have rolled by since the Quails "came up and covered the camp of Hence the generic name *Lagopus*, signifying a "Hare'sfoot."

the Israelites," yet the species still survives, and its gregarious and migratory character remains unchanged.

One of the Grouse tribe the Capercaillie, or Cock of the Woods (*Tetrao urogallus*), formerly existed both in Britain and Ireland, but has, unhappily, been extirpated. This splendid bird attained the size of a Turkey, and by some writers is even spoken of as the Wild Turkey. Attempts for its re-establishment are now being made, and with prospects of success. It is found in Sweden and Norway, and other parts of the north of Europe.

Struthionidee. The Bustards are birds of rare occurrence. The Great Bustard (*Otis tarda*) has long been extinct in both Scotland and Ireland: in England it is spoken of rather as one which had recently "a local habitation," than as one actually indigenous at the present time. The Little Bustard (*Otis tetrax*) is an occasional visitant.

ORDER IV. GRALLATORES. WADING BIRDS.

"No more thy glassy brook reflects the day, But, chok'd with sedges, works its weedy way; Along thy glades, a solitary guest, The hollow-sounding Bittern guards its nest: Amidst thy desert walks the Lapwing flies, And tires their echoes with unvary'd cries,"

GOLDSMITH'S DESERTED VILLAGE.

THERE are some birds whose legs are so long that the body seems as if mounted on a pair of stilts, and this peculiarity is that which is expressed by the scientific name for the present order Grallatores a Latin word, literally meaning those who walk on stilts. The lower part of the leg is naked, and from this circumstance, as well as from its length, is especially adapted for wading. Hence, birds of the present order are called "Waders."

But although this term is very correct as applied to some, it is altogether incorrect with regard to others: thus, the Ostrich (Fig. 249), which lives remote from the sea, and from the banks of rivers, is included; and birds which, like the Plover, are not remarkable for great length of leg, are also included. The fact is, that here, as in other great groups, the characteristics must be sought in some which may be looked upon as the types or representatives of the order, and not be rigorously required in every individual that naturalists may place in the same assemblage.

Cuvier arranges, in one family, all the birds of the present order whose wings are not adapted for flying, as those of the Ostrich (Fig. 249), and of the Cassowary (Fig. 238). Here, also, is placed the Apteryx (Fig. 275), the wingless bird of

Fig. 275. APTERYX.

New Zealand. It is a creature so strange, that no imagination could have fancied a bird without wings or tail, with robust legs, claws suited for digging, and actually used in forming excavations in which this singular bird lays its eggs and hatches its young. When we add that its habits are nocturnal, we have stated the most striking peculiarities of a bird which is now rare, and may possibly become extinct. Dissection shows the existence of the wing-bones, but in a rudimentary state. This entire division is without any representative among our native birds.

Charadriadee. The Plover is the true representative of this family, and derives its name from the French "Pluvier" a term given because the bird appears in large migrating flocks in the rainy weather of spring and autumn. The Golden Plover (*Charadrius pluvialis*) frequents swampy grounds and solitary bogs. It is one of these birds which appear to have a double moult. The real moult, or actual change of

feathers, occurs in autumn; in spring some new feathers appear, and others undergo a change of colour; so that the aspect of the bird alters twice in the course of the year. The Golden Plover, and still more, the species next mentioned, exhibit a

Professor Owen on the Apteryx, Trans. Zool. Society.

great variety of devices to draw any intruder away from the vicinity of the nest or young; feigning lameness, or allowing a wing to droop as if it were broken, and thus tempting the inexperienced visitor to follow in the hope of taking the bird prisoner.

Besides different species of Plovers, this family contains the Lapwing or Peewit (*Vanellus cristatus*). To this bird the term "elegant" is peculiarly appropriate, from its figure, its crest, its plumage, and the ease and vivacity of every movement. The English name Lapwing is given because of the slow movement of its wings in flight. Its peculiar note has suggested the other name of Peewit. The French convey an idea of its cry by the words diw-huit. It gives life and interest to the wildest moor. The stratagems it employs for the safety of its young are well known, and are mentioned by every observer of its habits.

Gruidge. The common Crane (*Grus cinerea*. Fig. 276), is a very rare visitant in England; and in Ireland has been unknown for more than a century, t Mr. Gould says, "Flocks of the birds are seen at stated times in France and Germany, passing northwards and southwards, as the season may be, in marshalled order, high in the air, their sonorous voices distinctly heard, even from their elevated course." It is said to winter in Africa.

Ardeidce. The common Heron (*Ardea cinerea*) is probably one of the best known birds belonging to the present order. Its motionless attitude as it watches for its prey in the shallow of the river or the sea, cannot fail to have attracted Fig.

attention, adding, as it not unfrequently does, to the pictu-

M. Edwards' Elements, p. 121.

f Smith, in his History of Cork, states it was seen during the remarkable frost of 1739. Thompson's Report on the Irish Fauna, resque effect of the scene. Nor less striking is its appearance on the wing, the long outstretched legs acting as a counterpoise to the head and neck. It is a singular spectacle to behold these hirds collecting in spring at their "building stations, occupying like Rooks the upper branches of high trees, and beginning once again the important business of incubation. They do not invariably chose such situations, but occasionally select precipitous rocks near the coast, as at the Great Orme's Head. On the Scotch coast, near Cromarty, Mr. St. John describes a heronry, at which some of the nests were built in clusters of ivy, and others on the bare shelves of the rocks. It seems strange, when possessed of ample power to range and choose at pleasure, that the same bird should select situations so very dissimilar.

The Common Bittern (*Botaurus stellaris*. Fig. 277) is no longer a common bird, and is every year, as waste lands are reclaimed, becoming more rare. During the breeding season it utters a loud booming or bellowing noise, t to which some of our poets have alluded.

"But the Lark's shrill fife shall come At the day-break from the fallow, And the Bittern sound his drum, Booming from the sedgy shallow."

LADY OF THE LAKE.

Thomson, in his notice of the bird, has embodied an erroneous but current opinion, as to the manner in which the booming noise is produced:

Fig. 277. BITTERM.

' So that scarce

The Bittern knows his time, with bill ingulph'd, To shake the sounding marsh." SPUING.

Living remote from human haunts, on the marsh, the bog,

Wild Sports of the Highlands, p. 123.

f This bellowing may have suggested the term *Botaurus*, meaning a Bull.

and the quagmire, it continues to this day the emblem of desolation and solitude, as it was at the time when the Prophet proclaimed against Babylon the awful denunciation: "I will also make it a possession for the Bittern, and pools of water; and I will sweep it with the besom of destruction, saith the LORD of hosts."

The Stork (*Ciconia alba*) is another member of the same family that must not be passed by without mention. Those who have travelled in Holland and other parts of the continent, know the favourable light in which it is regarded, and the arrangements made for its accommodation and protection. The affection of the Stork for its young, is one of the most remarkable traits in its character; it is only needful to refer to the female, which at the conflagration of Delft, after several unavailing attempts to remove her young, chose to remain and perish with them, rather than leave them to their fate. Among the ancient Egyptians the Stork was regarded with reverence inferior only to that which was paid to the Sacred Ibis (Fig. 278). The Ibis itself is a member of the present family; one species, the Glossy Ibis (*Ibis falcinellus*), has been taken both in England and Ireland.

Scolopacidae. This family comprises the Curlews, Sandpipers, Snipes, and other well known birds. It may be well represented by the Woodcock (*Scolopax rusticola*), a migratory species, ranging from Africa to Scandinavia. It flies by night, and seems in these countries to feed principally on the common Earthworm. The fact is now established, that all the Woodcocks do not leave these islands, but that a small though gradually increasing number are permanently resident, and regularly lay their eggs and bring forth their young. This is mainly attri-

Vide Bennett's Gardens and Menageries, p. 20.

buted to the shelter afforded by the increased extent of plantations.

Rallidae. Of the Land and Water Rails, the best known individual is the male bird, whose peculiar yet not unpleasing "crake" is heard from our meadows in spring and the early part of summer, and has gained for the species the name of "Corn-crake." To the same family belong the active Water-hen (*Gallinula chloropus*) and the common Coot (*Fulica atra*). Respecting the habits of both of these, the Bishop of Norwich relates many pleasing particulars to which we refer our readers, f as the space to which we are restricted forbids their introduction here. There is a marked difference in the foot of the two species. In the Water-hen the toes are long, and are fringed on each side by a narrow membrane. In the Coot the membrane is increased in size, assumes the form of rounded lobes, and unites the toes towards the base, thus indicating an approach to the complete webbed foot, which is characteristic of the swimming birds, which constitute the next order.

ORDER V. NATATOIRES. SWIMMING BIRDS.

' Some sought their food among the finny shoals, Swift darting from the clouds,
emerging soon With slender captives glittering in their beaks."

MONTGOMERY'S ' : PELICAN ISLAND."

IN the birds of this order the bill is variously shaped. The legs short; often placed far behind, adapted for swimming, j The feet using that word in the ordinary sense differ in form, and in the extent to which the toes are webbed; the part above the foot is much narrower in front than at the sides, and hence offers less resistance to the movement of the foot when the bird is swimming.

Here, as in other instances, 'a doubt may exist as to whether

Full information on many points of interest in the habits of this bird, may be found in a paper by Mr. W. Thompson, *Annals and Mag. Nat. Hist.* January, 1839.

t *Familiar History of British Birds*, vol. ii.

J *Jenyns' Manual*.

a particular species should rank in the group under consideration, or in one to which it is allied by striking peculiarities of structure. In the Flamingo (Fig. 279) we have the long

Fig. 279. FLAMINGO.

legs of the Waders combined with the webbed feet of the Swimmers; and, accordingly, a different place has been assigned to it by different naturalists, as they attributed a greater or less degree of importance to certain characters. Such points we pretend not to determine; we would rather mention that the generic name (*Phcenicopterus*) means, literally, " wings of flame;" and African travellers describe the appearance of the birds, when assembled in ranks, in a manner which bears out the accuracy of the picture presented by the poet:

"Flamingoes, in their crimson tunics, stalk'd On stately legs, with far exploring eye;
Or fed and slept in regimental lines, Watch'd by their sentinels, whose clarion-screams
All in an instant woke the startled troop, That mounted like a glorious exhalation, And
vanished through the welkin far away."

MONTGOMERY'S " PELICAN ISLAND." H2

From the great extent of coast and the varied character of the British Islands, the birds of the present order are so numerous as to constitute more than one-fourth of the entire of the native species. They are arranged in five families, according to the form and structure of the bill, the wings, the toes, and the position of the legs.

Aruaidce The first of these comprises Geese, Swans, Ducks, and allied species. Most of the Wild Geese are winter visitants to these countries; and the long strings in which they are seen to fly, changed at times into a wedge-shaped figure like that of the letter j, cannot be looked on without admiration.

The two best known species are the Bean Goose (*A. segetum*) and the White-fronted Goose (*A. albifrons*) and of these the Bean Goose is much the more common. These birds are remarkable for their watchfulness, not only at night, but during the time of feeding. Before alighting for this purpose on a field of new-sown grain, they make several circling flights, to see if all be safe, and then commence feeding. They take the precaution, however, to plant a sentry, who, as Mr. St. John informs us. t " either stands on some elevated part of the field, or walks slowly with the rest never, however,

venturing to pick up a single grain of corn, his whole energies being employed in watching. When the sentry thinks he has performed a fair share of duty, he gives the nearest bird to him a sharp peck. I have seen him sometimes pull out a handful of feathers if the first hint is not immediately attended to, at the same time uttering a querulous kind of cry. This bird then takes up the watch, with neck perfectly upright, and in due time makes some other bird relieve guard."

The Bernicle *A. bernicla* and the Brent Goose (*A. brenta*) are regular winter risitors, and abound in certain localities. The Brent Goose is killed during the season in great numbers, being esteemed for table use. In Belfast Bay it is always called the "Barnacle."

The appearance and habits of the Swan are so well known, that it is needless to dwell upon them. There are, however, two species of Wild Swan which visit these countries in winter, and present some interesting peculiarities. If the skater, in the midst of his evolutions on the ice, should chance to

Latin, *Anas*, a Duck. This family is now subdivided, the Wild Sports of the Highlands, p. 107.

hear a loud hooping cry, and notice a flight of birds of large size, and of powerful pinions, passing over his head at a great elevation, he will not fail to remember the Hooper, or Whistling Swan (*Cygnus ferus*). In entire contradistinction to this species, the one which is domesticated is termed the Mute Swan (*C. olor*; yet it is respecting this bird that the fable became current, that it foretold its own death, and sung with peculiar sweetness at its approach. Thus Shakspeare: ' I will play the Swan,

And die in music." But, although the voice of the Swan is but little noticed, the bird is not really mute, as its name would imply; the notes are soft and low, and are described as " plaintive, and with little variety, but not disagreeable." The classical scholar will call to mind the well-known line, in which the existence of a Black Swan is spoken of in a manner which implies the utter disbelief in the existence of such a bird; yet, among the strange creatures which New Holland has sent to us, are Black Swans: these are now distributed over many parts of these kingdoms where aquatic menageries are established, and form, by their dusty hue, a striking contrast to the snowy tint of their conveners.

Fig. 280. EIDER DUCK.

The Sheldrake, the various species of Wild Ducks, with the Teal and Widgeon, we must pass by. The Eider Duck (*Somateria mollissima*, Fig. 280) deserves especial notice, as

Yarrell.

it supplies the valuable eider-down of commerce. This bird is a very rare visitant to the Irish coast, but is permanently resident in some places on the northern shores of Britain. Its great haunts, however, are the coasts of Norway, Lapland, Iceland, and other localities still farther north. The down is plucked by the female from her breast, and spread over the eggs. The fowlers, to whom the districts frequented by the Eider Duck become a valuable property, carry off both eggs and down, the eggs being used by them as food. The Duck again lays, and her nest in like manner is again despoiled. She lays a third time, the male supplying such of the down as she can no longer furnish, and she is then allowed to rear her young without molestation.

Colynibidce. The Grebes and the Divers constitute the present family; and a glance at the annexed figure of the

Fig. 281. GREAT NORTHERN DIVER.

Great Northern Diver (*Colynibus glacialis*, Fig. 281), will convey a better idea of the different aspect of the members of this and the preceding group, than any description. The Divers, as their name implies, are remarkable for their diving powers, thus pursuing their prey and evading their enemies. The bird figured belongs to a species which may be said to live upon the water, except during the time devoted to the rearing of the young. It is a winter visitant to both the British and Irish coasts, and has occasionally been met with in summer. Like the Gannet, it is sometimes entangled in the nets of the fisherman; and Mr. W. Thompson has related to us one instance in which a Diver, when thus taken, was found to have swallowed a hook, having doubtless been attracted by the tempting appearance of the fish-bait.

Alcidce. The Guillemots resemble in many respects the Divers. We pass them by to notice the Puffin (*Alca arctica*), a bird common round our coasts during the summer months. Its most striking peculiarity is the bill, which has gained for it the titles of "Sea-parrot," and "Coulter-neb." To this family belongs the Penguin (Fig. 282), whose singular plumage has been already noticed (ante, p. 303). The wings, so powerless for flight, are, however, most efficient as fins. When at sea and fishing, it comes to the surface, for the purpose of breathing, with such a spring, and dives again so instantaneously, that no one could at first sight be sure it was not a fish leaping for sport. The Penguin is not deficient in courage. At one of the Falkland Islands, Mr. Darwin placed himself between one of these birds (*Aptinodytes demersa*) and the water. "It was," says he, "a brave bird; and till reaching the sea, it regularly fought and drove me backwards.! Similar intrepidity was evinced by some Penguins met with by Captain Ross in the late Antarctic expedition. The birds, from their great size, were named the "king" and the emperor," for there were two species. But both, however, evinced equal hardihood, and showed their determination to do battle for their land of nativity, even when opposed to British seamen.

Pelecanidce. The name of this family implies that it may be represented by the Pelican. We have but three native species, of which the most common is the Solan Goose

Darwin's Journal, p. 257. f Idem, p. 256.

(ante, p. 307). The other two belong to one genus, and are known to every one by character, if not by appearance; for to eat like a Cormorant has become almost the simplest mode of expressing great voracity. The common Cormorant (*Phalacrocorax carbo*), when gorged with food, is to human eyes so unattractive that it is under this form Milton describes Satan, after he had gained admission into Paradise:

"Up he flew, and on the tree of life

Sat like a Cormorant devising death To them that lived."

The Chinese employ the Cormorant in fishing. A ring is placed round the neck of the bird to prevent the prey being swallowed, and as soon as a sufficient number has been obtained for its master the ring is removed, and the bird allowed to fish on its own account.

Laridge. The Terns, Gulls, and Petrels belong to the present family. The Terns are also called Sea-swallows, a term expressive of ease and rapidity of flight, and of some resemblance in other respects, among which the long-forked tail is perhaps the most striking (Fig. 283). They live upon

Fig. 283. TERN.

small fish, and flying some yards above the water, dart down with such quickness and precision as rarely to miss the object of their aim.

The Gulls are, however, better known than either of the other tribes. The mariner finds them in all seas; and the landsman who visits the coast cannot fail to remark their graceful flight,

Hirondelles de mer of the French authors.

the buoyant case with, which they ride upon the waves, and the animation which they give to the scene. Perhaps few ordinary occurrences are more striking than what is termed a "play of gulls;" when the birds, having discovered a shoal of young fish, are swimming among them, hovering over them, uttering wild screams of joy, plunging down into the midst of the shoal, and gorging their prey with riotous delight. This, however, is not their only food. The carrion and the offal of the beach are not less acceptable; and two of our largest native species attack wounded birds, and will even carry them off before the shooter, by whom they have been struck, can reach the spot. "When, says Mr. St. John, "I have winged a duck, and it has escaped and gone out to sea, I have frequently seen it attacked and devoured almost alive by these birds."f

Their voracious appetite occasionally brings them into peril. Thus the Kittiwake and other Gulls are taken at Ballintrae, in Ayrshire, by hooks baited with the liver of the cod-fish, and are sold for the sake of their feathers. In other localities the Gulls seek to diversify their fare in spring-time by visiting the fields, and picking up the grubs and worms which the plough brings to the surface; and at Horn Head, in the County Donegal, the Herring Gull (*L. argentatus*) is said to destroy young rabbits, j

The precipitous cliffs, and the low lying ledges of rocks, on which the various species of Gulls build their nests and bring forth their young, are, in many respects, interesting objects for contemplation. At first sight all seems confusion, and the nests indiscriminately mingled; but a little further examination shows that order prevails amid the apparent disorder, and that each kind of Gull apparently gives a preference to a certain situation. But these are not their only breeding haunts; the little island in a retired mountain lake, and other island localities of a similar kind are favourite places of resort. In Norfolk, at a distance of thirty miles from the sea, thousands of the Black-headed or Red-legged Gull (*L. ridibundus* Fig.

The Great Black-backed (*Larus marinus*), and the Herring-Gull (*. argentatus*).

f Wild Sports of the Highlands, p. 216.

j The principal points of information in this paragraph are derived from the MS. Notes of Mr. W. Thompson, which have been most kindly placed at our disposal.

284) annually take possession of an island about thirty acres in extent, and build their nests. In Ireland, the Black-headed Gulls frequent, for the same purpose, the gravelly beach of a portion of Ram's Island in Lough Neagh; and so closely are the nests placed over the ground, that Mr. W. Thompson

Fig. 284. BLACK-HEADED GULL.

informs us, that he and some friends, when visiting the place, had to use great circumspection in putting down their feet, that they might not do injury to the nests or eggs. This species, as stated by the gentleman just mentioned, is that which is most abundant in Belfast Bay, and not the one to which the name of "Common Gull" (*L. Canus*) is applied. Their evolutions are extremely varied and beautiful, exhibiting both power of wing and grace of movement.

Of the Petrels, the best known species is that which is the smallest of British web-footed birds, the Stormy Petrel (*Thalassidroma pelagica*). They crowd round vessels before and during stormy weather, partly for the sake it is supposed of shelter, and partly for that of food. Sailors regard them with superstitious feelings, and have long given them the name of "Mother Carey's Chickens" from some hag of the olden time, whose name would have passed into oblivion had it not been

Bishop of Norwich's Familiar History of Birds, vol. ii. p. 246.

associated with those harmless little birds. Their dusky plumage, diminutive size, their habit of running upon the surface of the water, and the circumstances under which the mariner sees them, account very naturally for the feelings with which he regards them. Very differently are they viewed at St. Kilda, one of the northern islands of Scotland. There the birds are regarded as benefactors, giving the means of light throughout the long nights of winter; for so full of oil is the body, that a wick passed through it will burn as if fed from the oil-reservoir of a lamp. The usual practice of the inhabitants, however, is to collect the oil by itself. Mr. John Macgillivray, who visited the Hebrides in 1840, states, "the bird sits very close upon the nest, from which it will allow itself to be taken by the hand, vomiting on being handled a quantity of pure oil, which is carefully preserved by the fowlers, and the bird allowed to escape." A larger species, the Fulmar Petrel (*Procellaria glacialis*) is even more valuable to the inhabitants of St. Kilda. "This bird," says Mr. J. Macgillivray, "exists here in almost incredible numbers, and to the natives is by far the most important of the productions of the island. It forms one of the principal means of support to the inhabitants, who daily risk their lives in its pursuit. The old birds, on being seized, instantly vomit a quantity of clear and amber-coloured oil, which imparts to the whole bird, its nest and young, and even to the rock which it frequents, a peculiar and very disagreeable odour." Within the last few years only, according to Mr. W. Thompson, has the Fulmar been known to visit the Irish coast. The Stormy Petrel, on the contrary, is at all times to be met with on the western shores, and breeds on several of the islands which are washed by the Atlantic. f Mr. George C. Hyndman, who visited Tory Island, off the north coast of the County Donegal, found the Stormy Petrel living comfortably in the Rabbit burrows, and there bringing out its young. After the hurricane of the 7th of January, 1839, Petrels were found not only in the central parts of Ireland, but even in the extreme east, having been driven across the island by the violence of the gale. J

Edinburgh New Phil. Journal. t W. Thompson's Report on the Fauna, 1840.

j W. Thompson, Note on the Effects of the Hurricane on the Lower Animals. Annals of Natural History.

Mr. Darwin, in speaking of another species (*Puffinus cinereus*), which is common to Cape Horn and the Coast of Peru, as well as to Europe, remarks, "I do not think I ever saw so many birds of any other sort together, as I once saw of these behind

the Island of Chiloe (off the west coast of Patagonia); hundreds of thousands flew in an irregular line for several hours in one direction. When part of the flock settled on the water, the surface was blackened, and a noise proceeded from them, as of human beings talking in the distance. At this time the water was in parts coloured by clouds of small Crustacea."

Of the multitude of birds of one species that occasionally assemble together, examples have been given in the Starling (p. 352), the Passenger Pigeon (p. 365), and the Quail (p. 366); we have here another instance of the same remarkable fact, the birds themselves belonging to a different order, inhabiting a different region, and seeking their appointed food on the sea instead of the land.

If we turn from the birds now living, to the consideration of those that are extinct, we find their remains are much less numerous than those of fishes, reptiles, or quadrupeds. ' ' Their powers of flight,"' as Mr. Lyell remarks, ' i insure them against perishing by numerous casualties to which quadrupeds are exposed during floods; and, if they chance to be drowned, or die when swimming on the water, it will scarcely ever happen that they will be submerged so as to be preserved in a sedimentary deposit, "f This is easily accounted for when we consider, that, from the tubular structure of the bones, and the quantity of feathers, their bodies are extremely buoyant, and most generally float on the surface of the water until they rot away or are devoured. Yet, among the fossils of the London clay, and of the Paris basin, are those of several birds, specifically different from any that now exist.

There is one species recently extinct, but known by the descriptions of navigators about two centuries ago, by parts of the body preserved in different collections, and by paintings in the British Museum and elsewhere. It was called the Dodo, and was a native of the Mauritius. Its figure was massive; its weight, perhaps, forty-five or fifty pounds, and its wings so short as to be useless for flight. Much difference of opinion Journal.

t Principles of Geology, vol. iii.

has existed among naturalists as to the tribe of birds to which the Dodo should be referred. From the bulky figure some thought it resembled the Turkey; while, from its hooked bill, it was thought by others to have belonged to the birds of prey. ' A recent examination of the bones composing the skull and foot, now in the Ashmolean Museum, in Oxford, has, however, proved that it is allied to the Pigeons, a tribe with which it was not supposed to have had any connection. Other birds allied in character to the Dodo inhabited the neighbouring islands of Bourbon and Rodriguez, all of which appear to have been sought for with uncalculating eagerness by the early colonists, and thus were speedily extirpated.

We have mentioned (p. 273) that a gigantic reptile had left its foot-prints on the moist beach of the ancient sea. Similar testimony has made known the existence in former times of birds which have left no other trace behind. These foot-prints have been noticed in England, but more abundantly, and of larger size, in America, suggesting the idea of birds possessed of dimensions far beyond those attained by any living species. The impress of the human footstep on the beach of that island which Robinson Crusoe believed to be his own solitary domain, was scarcely more startling. Yet here, as in other instances, the marvel of the truth surpassed that of the conjecture.

Numerous bones were transmitted from New Zealand to England, which, on examination by Professor Owen, were found to belong to wingless birds of nine different species, some of them of gigantic size. They were referred by him to the same genus, under the name *Dinornis*.

The annexed outline (Fig. 285), exhibits the figure of one of these birds and that of a man, the relative proportions of both being preserved; it thus furnishes an easy mode of estimating their comparative dimensions.

The number of wingless birds, and the vast stature of some of the species peculiar to New Zealand, have suggested the idea, that the present island may be but the remnant of a larger tract or continent, over which they formerly ranged.

Natural History and Osteology of the Dodo, Solitaire, and other extinct birds, by H. E. Strickland, Esq. and Dr. Melville.

f Professor Owen's Memoirs on the genus *Dinornis*. Transactions of the Zoological Society, parts 3 and 4, vol. iii.

f Literally, a enormously large bird."

"One might almost be disposed," says Professor Owen, "to regard New Zealand as one end of a mighty wave of the unstable and ever-shifting crust of the earth, of which the opposite end, after having been long submerged, has again risen with its accumulated deposits in North America, showing us, in the Connecticut sandstones, the foot-prints of the gigantic birds which trod its surface before it sank; and to surmise that the intermediate body of the land-wave, along which the *Dinornis* may have travelled to New Zealand, has progressively subsided, and now lies beneath the Pacific Ocean."

Fig. 285. D

Memoir on *Dinornis*, part 4, vol. iii. p. 328.

f This outline is copied, with the kind permission of Professor Ansted, from his Picturesque Sketches of Creation; a highly attractive and interesting volume. VAN VOORST.

WE have now reached the class which ranks as the highest of the animal kingdom; and to which man himself belongs. Here only do we find organs especially adapted for supplying to the young, during the prolonged period of helpless infancy, that fluid nutriment, to which we give the name of milk. This organization is so characteristic, that from the Latin word *mamma*, signifying paps or teats, is derived the term *mammalia*, the scientific appellation by which the class is distinguished. Every animal that suckles its young may, from that circumstance, be referred to the present class.

Circulation. The blood is warm, and the heart, as in birds, consists of four compartments. The general arrangement of the arteries through which the aerated blood in man is propelled, is shown in the annexed figure (286) which may be compared with Fig. 241, exhibiting the arterial system in the preceding class.

"Neither the circulation nor the respiration are quite so active, nor is the animal heat quite so great as in the class of birds."

Expiration. All the *mammalia* breathe by lungs. These are not attached to the ribs as in birds, but are suspended in a cavity at the upper portion of the trunk (thorax).

They are divided into a multitude of minute cells into which air is conveyed by the branches of the windpipe. In the annexed

Owen.

Fig. 286. AR-

Fig. 286. ARTERIAL SYSTEM OF MAN. a, temporal artery; b, carotid artery; c, aorta; d, renal artery; ?, iliac artery; , femoral artery, g, anterior tibial artery; , artery of foot; i, vertebral artery; j, subclavian artery; A-, axillary artery; I, brachial artery; w, coeliac artery; w, radical artery; o, posterior tibial artery; p, peroneal artery.

representation (Fig. 287) these air-tubes are shown at one side, and the lung in its natural condition on the other, The reader is thus furnished with the means of comparing these important organs in man, with those which have been already exhibited (Fig. 242) as existing in birds.

Covering. While scales form the characteristic covering of fishes, and feathers of birds, hair may be said to be that of the mammalia. It is not invariably present, and it undergoes many modifications in its appearance. We term it wool upon the sheep; the same material becomes spines upon the Hedgehog, and "quills upon the fretful Porcupine" (Fig. 288). It even assumes an aspect still more extraordinary, and is converted into bony

Fig. 287. AIR-TUBES, AND LUNGS OF MAN.

Fig. 288. POUCCUPINE.

plates in the defensive covering of the Armadillo (Fig. 311).

Skeleton. By far the greater number of the animals belonging to this class move on the ground by the action of four feet, from which circumstance the name quadruped has been restricted to them. It is occasionally used in a more general sense, as synonymous with the scientific term mammalia. The outline of the skeleton conveys, in most cases, an idea of that of the body; but occasionally, as in the hump of the Camel (Fig. 289), there exists in the living animals

Fig. 289. SKELETON OF CAMEL.

some peculiarly striking feature, which is not represented in the bony framework. The hump, in the present instance, consists of fatty tissue, and is well known to diminish in size, and nearly to disappear when the animal is exposed to long-continued privation.

The possession of four feet used for the purposes of locomotion, though general in the mammalia, is by no means

Fig. 239. Skeleton of the Camel on a black ground, exhibiting an outlin. of the animal: vc, cervical vertebrae; vd, dorsal vertebrae; vl, lumbar vertebrae; vs, sacral vertebrae; vg, caudal vertebrae; e, ribs; o, scapula; h, humerus; cu bone of fore-arm; ca, carpus; me, metacarpus; ph, phalanges; fe, femur; ro, patella; ti, tibia; ta, tarsus; mt, metatarsus. Ing. 290, the corresponding parts are indicated by the same letters as in fig. 289.

universal. In the true monkeys, all the extremities are shaped like hands, and are used for prehension as well as for locomotion. In the Bats, that part of the anterior extremities which corresponds to the fingers of the human hand, is enormously developed, and forms the bony framework of the wings (Fig. 334). In the Seals (Fig. 290), the extremities

Fig. 290. SKELETON OF SEAL.

are converted into paddles; and there are some warm-blooded herbivorous animals inhabiting the sea, in which the hinder legs are altogether wanting.

The number of vertebra or joints in the spinal column varies much in the several tribes, the difference depending principally upon the presence or absence of the tail, and the varying number of its parts. A remarkable uniformity prevails in the structure of the neck. The short thick neck of the Elephant, and the long slender neck of the Giraffe, contain, precisely the same number of vertebra, namely, seven. This is the invariable number, though there are a few apparent exceptions. The mammalia present in this respect a singular contrast to birds (ante p. 298), and show how in the mechanism of the animal frame, similar results may be attained by the most opposite arrangements.

Head. The head differs greatly, not only in size and form, but also in what may be regarded as its appendages. The Tapir, an animal allied in many respects to the Hog, has the

For description, see footnote page 388. VOL. it, I snout prolonged into a fleshy proboscis (Fig. 291), which is capable of extension or contraction, but does not act as an instrument of prehension. The Elephant, on the contrary (Fig. 322), is furnished with an organ remarkable for its varied powers of action, combining in the highest degree delicacy and strength. In both these instances the proboscis is a prolongation of the muscular fibre and covering, and not

Fig. 291. HEAD OF TAPIR.

Fig. 292 RHINOCEROS.

a distinct appendage. The Rhinoceros (Fig. 292) has a weapon which is found adhering to the skin, not growing from the skull; it is regarded as hair growing in a mass, and presenting the appearance of a solid horn. The Giraffe has bony protuberances, the rudimental representatives of the curved or branching horns with which other tribes of ruminating animals are furnished. In the Stag the horns have at

Fig. 293. THE STAG.

first a hairy skin: when this has worn away and the horns have remained bare for a time, they are thrown off, and their place is supplied by others. In structure they resemble solid bone, from which circumstance the animals of the Deer trihe are termed Solid-horned Ruminants. The quantity of bony matter thus annually secreted is very remarkable. In the large extinct species, popularly known as the " Irish Elk," the Antlers weighed from 60 to 70lbs. and as in the existing males, were the growth of a single year. In the Ox and the Goat (Fig. 294), these organs are formed of the elastic substance which we call horn, and which is analogous to that of the hair and hoofs. They are hollow within, cover the bony axis like a sheath, and "continue to grow throughout life, but ' Fig." 294. HEAD OP GOAT. only at intervals, depending upon the season of the year, the age of the individual, and the supply of food." To these animals the name of Hollow-horned Ruminants has been applied; the bony core of the horns is formed of cells, which communicate with the nose, and are thus filled with air. By this arrangement lightness is added to strength.

The tusks of the Elephant, though appendages exterior to the head, are in reality a part of the dental system of the animal, and are the representatives of those teeth

which in man are known as the cutting or incisors. " They not only surpass all other teeth in size, as belonging to a quadruped so enormous, but they are the largest of all teeth in proportion to the size of the body." 't Tusks of the Mammoth, an extinct species of Elephant, have been found from nine to eleven feet in length, and one has been known to weigh so much as one hundred and sixty pounds. The importance of these tusks as an article of commerce may be estimated from the fact, that in 1737, an account was published of the Mammoth's bones and teeth found in Siberia; and of the uses to which the tusks were applied; and "from that time to the present there has been no intermission of the supply of ivory furnished by the tusks of the extinct Elephants of a former world. "J

Ogilby. Monograph of the Hollow-horned Ruminants. Transactions of the Zoological Society of London.

f Owen's Odontography. J Idem.

Another appendage to the head, and of great value in a commercial point of view, is that which is popularly, though not very correctly termed " whale-bone." It is not bone, hut a series of horny plates, the substitutes of the true teeth, which in the whale are altogether wanting. The position of these plates is shown in the annexed figure (Fig. 295); they form a complete fringe suspended from the margin of the upper jaw, and when the whale closes its enormous mouth, they act as a seive, permitting the water to pass through, and enabling the animal to retain the small gelatinous and molluscou creatures on which it lives. The " Baleen" or Whalebone, is so important an article of trade, that hundreds of tons are annually brought into Britain, won by her intrepid mariners among the perils of the Arctic seas.

Teeth. We now pass on to the teeth, viewed as instruments for the mastication of food. In man they are thirty-two in number, when the series is complete; and the number is the same both in the Orang and Chimpanzee, They are of three

Fig. 295. SKULL OF WHALE.

Fig. 29S. TEETH OF MAN.

Molars.

Premolars. Canine. Incisors.

kinds, the incisor or cutting teeth, the canine which attain a large development in the Dog and carnivorous animals, and hence derive their name; t and the molar or grinding teeth.

Owen's Odontography, f Latin cam's, a dog.

There are eight on each side of the upper, and also of the lower jaw; thus amounting in all to thirty-two.

A few species of mammalia, as the Ant-eaters, are entirely devoid of teeth; in others there is a great diversity as to their number. The female Narwhal has two teeth, and both are concealed in the substance of the jaw. The Australian Water-rats have twelve. Most gnawing animals have twenty; but the Hares and Rabbits have twenty-eight. The Porpoise has between eighty and ninety, and the true Dolphins from one hundred to one hundred and ninety, f It is found that the arrangement of the teeth varies, according as the food is to consist of animal or vegetable substances, of soft flesh or horny covered insects: of tender herbs, or wood of greater or less degrees of hardness. Hence it is possible, merely by an inspection of the teeth, to determine,

with considerable certainty, the diet, the habits, and even the general structure of most of the mammalia. J

We never meet in nature with an incongruous union of parts. A Lion, with the hoof of a Horse, could not subsist;

Fig. 297. SKULL OF A GNAWING ANIMAL. Fig. 298. SKULL OF A BOAR.

it would die of hunger from inability to seize and retain its prey. In like manner, a Horse, with the teeth of a Lion, would starve in the midst of the finest pastures, from being unable to crop and triturate its food.

Zoologists have adopted a formula for expressing the number of teeth possessed by different animals at each side of the month, distinguishing those in the upper jaw from those in the lower jaw. The dental formula of man is written thus: Incisors; Canines; Premolars; Molars; = 32.

f Owen's Odontography. j M. Edwards' Elemens.

Bearing these facts in mind, let any one but look at the representations here given of the skulls and teeth of three of the most common quadrupeds, and he will at once be struck with the diversity of form and arrangements they exhibit, and the modifications of internal structure they indicate.

Fig. 299. SKULL OF A HORSE.

We are desirous, even at the risk of some repetition, that this matter should be clearly understood. The researches of the zoologist and the comparative anatomist, have proved the perfect dependence of one part of the animal form upon another. To this there is no exception; all living beings testify the same truth, and establish the unity of plan evinced by their organization. The geologist, in bringing to light the remains of the animals that in former ages were monarchs of the earth, adduces amid all their diversity of form, no example that is not in accordance with the same great truth.

Hence, it is obvious that if there are structural laws, to which all are subject, the comparative anatomist may from portions of the frame infer the size, the structure, and the functions of all the rest, and describe the conditions under which the animal had lived.

To the genius of Cuvier we are indebted for pointing out this mode of investigation, and showing the important results to which it leads. The path which he thus opened has been successfully explored, and has revealed much that was previously unknown. It has brought to light forms and proportions too strange for Fancy to imagine, but not for Science to delineate. The fossil bone has in the hands of the zoologist become instinct with life, and told the tale of its existence. It has furnished him with a spell more potent than the "open sesame" of the eastern tale, and unlocked the portals within which the history of a former world lay recorded.

The necessary dependence of one part of the animal frame upon another, is a principle that should ever be kept in view, and with which the mind of the learner should become familiar. We have seen, that according to the nature of the food, there is an adaptation of parts both internal and external; these are accompanied by corresponding habits. Hence the organs needful for the providing of food or in other words, the teeth, and of the extremities furnish, so far as external characters are concerned, a sound basis for classification; and as such they were regarded by Cuvier.

While, however, the system laid down by that distinguished naturalist in the last edition of his *Regne Animal*, is here adopted, it is not implicitly followed in every particular. Since the publication of that work, vast accessions to our knowledge of animals have been received, and impose the necessity of some changes in the classification. It would be contrary to the spirit of Cuvier not to concede what is thus demanded.

The following distribution of the inferior animals into ten orders, is that which is sanctioned by the writings of two British naturalists, whose opinion on such matters is entitled to the highest respect. † Man is also included under the distinctive term applied to that of which he is the sole representative, thus making eleven orders in all.

I. *Bimana* (two-handed) Man.

II. *Quadrumania* (four-handed) Monkeys.

III. *Cheiroptera* (finger-winged) Bats.

IV. *Insectivora* (insect-eating) Hedgehog, Shrew.

V. *Carnivora* (flesh-eating) Lion, Tiger, Bear. VI. *Cetacea* (whale-like) Whale, Porpoise.

VII. *Pachydermata* (thick-skinned) Elephant, Rhinoceros.

"VIII. *Ruminantia* (ruminating) Ox, Deer.

IX. *Edentata* (toothless) Sloth, Ant-eater.

X. *Rodentia* (gnawing) Rat, Hare, Squirrel.

XI. *Marsupiatia* (pouched) Opossum, Kangaroo.

It is quite impossible in any linear arrangement such as

The principal change is the separation of the Bats (*Cheiroptera*) and the Hedgehogs, c. (*Insectivora*), from Cuvier's order of "*Carnassiers*" or flesh-eating animals, and the elevation of those groups from the ranks of Families to that of distinct Orders. There are also changes with regard to the Marsupial animals.

f Professor Owen, in *Cyclopedia of Anatomy and Physiology*; and G. R. Waterhouse, Esq. in *Magazine and Annals of Natural History*.

the above, where the several orders follow each in regular succession, to convey an idea of the affinities which sometimes connect families that belong to orders widely separated in the scale. The same difficulty presents itself in every extensive assemblage of animals, showing, as has already been remarked (p. 28) that "the chain of beings of which the poet has sung, has no real existence in nature."

The number of animals belonging to the class *mammalia*, has been variously estimated, from 1149 to 1500; the latter number is that adopted by the learned authors of the *Physical Atlas*, as the basis of their calculations respecting the proportionate number of the species. The species described as British, amount to between eighty and ninety, and those recorded as Irish, to little more than one third of that number.!

In the limited space to which we are restricted, we shall not attempt to introduce those anecdotes illustrative of the habits of the Elephant, the Tiger, the Reindeer, &c. which are scattered throughout elementary works in general use. Our object shall rather be to point out how the different orders are characterised, and in what manner they are distributed.

With the laws affecting their geographical distribution, we are as yet but imperfectly acquainted. One of the most obvious causes which limit the growth of vegetables,

and the range of animals within certain bounds, is temperature. Heat and moisture stimulate the growth of plants, and wherever vegetation is most luxuriant, there the land animals are most abundant. They are confined within certain limits by the intervention of seas and of continuous ranges of mountains. But even when such obstacles do not exist, animals appear subject to certain climatic conditions, and pass not the limits which the Author of the Universe has fixed as the bounds of their habitation. Thus in North America, Mr. Lyell observes there are "several distinct zones of indigenous mammalia, extending east and west on the continent, where there are no great natural boundaries running in the same direction, such as mountain ridges, deserts, or wide arms of the sea, to check the migration of species. The climate alone has been sufficient to limit their range. The mammiferous fauna of New York, comprising about forty species, is distinct from that of the

Professor Bell's British Quadruped?.

t Thompson's Report on the Fauna of Ireland.

arctic region, six hundred miles north of it, and described by Dr. (now Sir John) Richardson. It is equally distinct from that of South Carolina and Georgia, a territory about as far distant to the south."

Our notice of the several orders of mammalia shall be commenced with those which are lowest in the scale, and gradually ascend to man, gifted as he has been with dominion "over every living thing that moveth upon the earth."

ORDER MARSUPIATA. MARSUPIAL, OR POUCHED ANIMALS.

' Deform'd, unfinish'd, sent before my time Into this breathing world, scarce half made up." RICHARD III.

The greater number of the mammalia are nourished prior to birth, by a network of blood-vessels named the placenta.- This is altogether wanting in the group now under consideration. While others do not come into the world until they are provided with all their organs, these are brought forth in an extremely imperfect state. The female in most instances is furnished with a peculiar pouch (Latin marsupium, a purse or bag), whence the scientific name for the order. In this pouch the immature young are received and nourished, and to it they afterwards retreat on the approach of danger. Certain bony projections, termed the Marsupial bones, are found in both sexes, even in those species in which the characteristic pouch does not exist.

"The order Marsupiatia," says Mr. Waterhouse, "embraces a large assemblage of quadrupeds, amongst which are those animals familiarly known as Opossums and Kangaroos. At

Travels in North America, vol. i. p. 172. The extract is given in Berghaiis and Johnston's Physical Atlas, from which all our information on the numbers and distribution of species is derived.

f The mammalia which are thus nourished are termed placental; the others the non-placental. Some naturalists regard this distinction of so great importance, that they consider the two divisions should rank as distinct classes.

VOL. II. I the present period, the great metropolis of the order is Australia; certain species of the group, however, are found in the Molucca Islands, and one genus, containing many

Fig. 300. SKELETON OF KANGAROO.

species " (the Opossums), "is peculiar to the New World' Their remains have been found in a fossil state in Europe, as well as in Australia and South America.

This order " presents a remarkable diversity of structure, (and consequently habits) containing herbivorous, carnivorous, and insectivorous species; indeed, we find among the Marsupial mammals analogous representations of most of the other orders of mammalia." Its most striking peculiarity is the premature birth of the young, and consequently the imperfect state of their development at that period. Professor Owen examined the young of the great Kangaroo, twelve hours after birth, and found its whole length from the nose to the end of the tail did not exceed one inch and two lines.! The corresponding measurement of a full grown male would be between eight and nine feet. J

"An animal so little advanced at the time of its birth as the young Marsupial, requiring a constant supply of food, and so ill fitted to bear the exposure which the more advanced young of other mammalia are subject to, must, it would appear,

Our information is derived from a valuable work now in course of publication, *Natural History of the Mammalia*, by R. G. AVaterhouse, Esq. and when practicable, we give the words of the original, marked by inverted commas.

f A line is the twelfth part of an inch.

j The body, measured from the tip of the nose to the root of the tail, being, according to Mr. Waterhouse, G3 inches, and the tail 42 inches.

perish, were not some peculiar provision made for its safety. In the pouch of the female we find this provision." Here the young remain firmly attached to the nipple of the mother, and supplied without effort and in perfect security, with the nutriment it requires. " This pouch, when the animal is very young, has its orifice closed, and glued as it were, to the body of the parent by a peculiar secretion. When the young animal is more advanced this secretion disappears, and the young frequently leave the pouch to return at will."

It has long been a question among naturalists in what manner is the young transferred to the pouch? On this point, an observation made on one of the female Kangaroos, at Knowsley, the seat of the Earl of Derby, gives the first precise information. Immediately on the birth of the young one, the mother took it up in her fore-paws, opened the pouch with them, and deposited the young within. In five minutes she was jumping about the place as if nothing had happened. ' '

Above one hundred and twenty species of Marsupial animals have been recorded, forming about one-twelfth of the entire number of mammalia. In size there is great diversity, ranging from a diminutive Opossum, which is little larger than the common Mouse, to the great Kangaroo already mentioned; and the disparity in size is still greater if we extend our view to extinct species, as Professor Owen, from the fossil remains of one brought from Australia, is of opinion that the animal must, when living, have been of bulk superior to that of the Rhinoceros.

Some Marsupial animals are so inferior in certain structural peculiarities to the rest, and approach so much in these points to birds and reptiles, that they form a distinct section bearing a distinct name (Monotrematd). To this division belong the Echidna and the Ornithoryncus (Fig. 301). The former is a little ant-eating animal, bearing externally some resemblance to a Hedgehog; the latter, a creature so anomalous, that

when the first specimens of it arrived in Europe, and naturalists saw the body of a quadruped joined to the bill of a bird, they

Proceedings of the Zoological Society, 12th Nov. 1844. Letter from the Rt. Hon. the Earl of Derby, President of the Society. In the instance referred to, the period of Utero-gestation was under one month.

f *Didelphys pusilla*.

j Signifying one orifice or outlet.

From two Greek words, the one signifying a bird, the other a beak. It is sometimes called the "Duck-billed Platypus." (flat-foot.) naturally suspected that the union was an artificial one. The real animal was in fact more wonderful than that which any dealer in "strange beasts," would have ventured to fabricate.

Fig. 301. ORNITHORYNCUS.

The Ornithoryncus is about eighteen inches long, and is called by the natives of Australia the water-mole. It frequents tranquil waters, seeking its food among aquatic plants, and excavating its burrows in the steep and shaded banks. The motion of its mandibles when procuring food are similar to those of a duck under the same circumstances.

The Kangaroos of Australia, form the family (Macropodidce) best known to Europeans. "They are vegetable-feeding animals, browsing upon herbage like the Ruminants, and it appears that in some cases they chew the cud like those animals. Some are of great size, being nearly as tall as a man when in their common erect position; others are as small as the common Hare, and indeed greatly resemble that animal in general appearance. "J About the beginning of the present century, but three species of the present group were known. They are now

A most interesting account of its habits is given by Mr. George Bennett, in the Transactions of the Zoological Society of London, vol. i.

JThe generic term *Macropus*, signifies long-footed. Waterhouse.

regarded as a family, subdivided into many genera, and containing numerous species.

We have a very vivid recollection of a scene we once witnessed at the Surrey Zoological Gardens. On the abdomen of a large bluish-grey coloured Kangaroo, we noticed two appendages, which a second glance told us were the fore-feet of the young one. In another moment, the head peeped out, and the young creature began gazing around. The mother then bent down, and, with great tenderness, began licking its face and head. These endear- Fig 302. KMGAE00.

ments being finished, the young one came out, and was amusing itself on the ground, when alarmed by a sudden noise, it jumped into the pouch, and was seen no more, leaving us as much astonished as when, in our boyish days, we first saw Harlequin escape from his pursuers by jumping through a picture.

Passing by the family (Phalangistidce) which includes the "Flying Squirrel," we come to that of the Opossums (*Didelphidce*). The Opossums are peculiar to America, and are found diffused from the southern border of Canada to Chili and Paraguay. "The largest known species scarcely equal in size the Common Cat, and by far the greater number, approaching more nearly to that of the Common Rat. "Their food consists chiefly of insects; but small reptiles, as well as birds and their eggs, are

attacked by the larger species. ' The feet are shaped like hands, and the hinder feet are furnished with opposable thumbs.

Some of the Opossums have no pouch, t or at least this reception for the young is found only in a very rudimentary condition in certain species, and the young, which at first remain firmly attached to the nipples, are subsequently carried

Waterhouse's Mammalia.

f From this circumstance they are included by Mr. Ogilby in the same order as the Monkeys, and regarded as belonging to that division to which he has given the name Pedimana.

upon the back of the parent." Such is the case in the species represented in the annexed figure (Fig. 303). It might puzzle us to imagine by what means the young could retain their places, while the mother was rapidly, changing her position among the branches of a tree. But the young Opossums adopt a Fig. SOS OPOSSUM. ready mode of guarding against the danger of a fall, by entwining their long tails round the tail of their mother.

ORDER RODENTIA. f RODENTS OR GNAWING ANIMALS.

THE preceding order was composed exclusively of animals belonging to foreign countries. The present is well represented among our native quadrupeds, as the British species amount to fourteen in number, and are illustrative of some of the most important families. The characteristics of the group are so well developed in the Rat and the Mouse, that the family to which they belong is regarded as typical of the order.

In the precise language of Mr. Jenyns the order is thus defined: " Incisors two in each jaw, large and strong, remote from the grinders; tusks none; toes distinct with small conical claws. "J The total number of species is six hundred and four, being two-fifths or nearly one-half of the entire number of mammalia known at the present time.

Fig. 303. The Marmose of M. Edwards' Elemens. The Murine Opossum (*Didelphus mvrina*), of Waterhouse and others.

From the Latin rodere, to gnaw; rodens, gnawing. The term glires is also applied to the present order, from the Latin glis, gliris, a Dormouse.

J Manual of British Vertebrate Animals.

G. R. Waterhouse, Esq. in Berghaiis and Johnston's Physical Atlas.

Fig. 304. SQUIRREL.

Geographical Distribution. On this subject Mr. Water-house remarks, that " species of the same group most frequently have a wide range in the same, or nearly the same parallels of latitude; but when the species are inhabitants of the high ridges of mountains, they will follow the course of the mountains, though that course may be in the opposite, or north and south direction." We learn from the same authority that the family of the Squirrels (*Sciuridce*, Fig. 304)' contains no less than 153 species. Few are found in South America; they are chiefly natives of the northern parts of that continent. Two, or perhaps three species occur south of the equator, but on the eastern side of the Andes only. They also become rare in the southern parts of the eastern hemisphere. The family (*Muridce*) to which the Rats and Mice belong, contains 306 species, and has the greatest geographical range. That to which the Porcupine is referred (*Hystriidce*) is, on the contrary, essentially American. " Out

of about eighty-seven species appertaining to this family, seven only are found out of the South American province, and these belong to the most highly organised divisions of the family." The groups of islands comprehended under the term Polynesia, have no representatives of the present order, except such as there is reason to believe have been introduced by shipping.

If instead of considering the Rodentia with reference to the great divisions of the globe, we limit our view to their distribution within the British Isles, we shall find that, out of fourteen species enumerated by Professor Bell, seven, or one half of the entire number are absent from Ireland. This is a singular fact when we consider how small an arm of the sea separates the two countries. The annexed figure (305) represents one of the Voles, little animals, which in many points exhibit a greater affinity to the Beaver than to the Mouse, with which in popular language they are associated. Of these there are in England three species; yet the genus (*Arvicola*) to which they belong, is altogether unrepresented in Ireland.

Fig. 305. SHORT-TAILED FIELD MOUSE.

Teeth. We turn from the geographical distribution of the Rodentia to the most striking characteristic of the order, the structure of the teeth. The Molar or grinding teeth, have

Fig. 306. MOLAR TEETH OF THE ARVICOLA.

Fig. 307. MOLAR TEETH OF THE BEAVER.

ridges of enamel variously arranged (Fig. 306, 307), which keep up the inequality of surface, as they wear less rapidly than the other portions. The incisor teeth, with their chisel-shaped edges, are however more remarkable. If a carpenter could lay hold of the wishing-cap of the fairy tale, and desire

The number actually recorded in the History of British Quadrupeds is fifteen; but since the publication of that valuable and beautifully illustrated work, Mr. W. Thompson has taken one from the number, by showing that the Irish and the Alpine Hare, instead of being distinct, are one species. To the "Report" of the latter gentleman on the Fauna of Ireland, we are indebted for the means of enumerating the British species which are not indigenous in Ireland. They are 1. The Squirrel (?) 2. The Dormouse 3. The Harvest Mouse (?) 4. The Water Vole 5. The Field Vole 6. The Bank Vole 7. The Common Hare

Scirrus vulgaris).

Myoxus avellanarius). (*Mus messorius*). (*Arvicola amphibius*). (*Arvicola agrestis*). (*Arvicola pratensis*). (*Lepus timidus*).

to possess a chisel which would never wear out, and would never become blunt, we might suppose that the handle of such a tool would have in itself the means of secreting the iron and the steel of which the blade is formed, of welding them together, and of giving them at the same time the needful polish and smoothness. And as such a gift would not partake of the imperfections of human workmanship, the new material would be deposited just in proportion as the old wore away, and the temper of the chisel would be neither too hard nor too soft, so that the edge would not be liable either to break or to turn, but remain at all times in working order. Such in reality is the mode of growth in the incisor teeth of the Rodentia (Fig. 297). New matter is ever added at the base, the tooth is ever growing, the enamel is deposited on the outer edge,

the softer or inner portions of the teeth wear away, and thus the bevilled or sloping edge of these most efficient tools is invariably preserved.

Knowing these facts, we cannot examine the teeth of the Rabbit, nor of the common Mouse, without being struck with the amount of design they exhibit, the care for the wants of the animal which they manifest, and the perfection in which the continual growth compensates for the constant wearing away. And these ideas become more vivid, and the convictions to which they lead more indelible, if we observe what takes place in cases where the usual order of things is interfered with. "When," to use the words of Professor Owen, "by accident an opposing incisor is lost, or when by the distorted union of a broken jaw, the lower incisors no longer meet the upper ones, as sometimes happens to a wounded Hare, the incisors continue to grow until they project like the tusks of the Elephant, and the extremities, in the poor animal's abortive attempts to acquire food, also become pointed like tusks: following the curve prescribed to their growth by the form of their socket, their points often return against some part of the head, are pressed through the skin, then cause absorption of the jaw-bone, and again enter the mouth, rendering mastication impracticable, and causing death by starvation."

Hibernation. We have in this order several examples of animals which hibernate, or pass the winter in a greater or less complete state of torpidity. Thus the Marmot of the Alps and Pyrenees dozes away the winter, until the sunshine

Odontography, p. 411, vide also plate 104, Fig. 5, in same work.

and the showers of April rouse it from slumber. The Hamster of the North of Europe (Fig. 308), lays up in its winter quarters a plentiful store of grain, which it conveys from the fields in its capacious cheek pouches. The provident instincts of both the Squirrel and the Dormouse of England, need only be referred to. The Jerboa, or Jumping Rat of Egypt (Fig. 309), although it does not hibernate, establishes magazines of grain; and thus "provideth her meat in the summer, and gathereth her food in the harvest."

Fig. 308. HAMSTER.

Fig. 309. JERBOA.

Utility. The annoyance, and occasionally the serious injury inflicted by some members of the present group, is universally admitted. On the other hand we should consider that substances which would soon be decaying and offensive, are removed by their agency; that the fur of some is much valued, and forms an extensive branch of trade, and that man himself, and many carnivorous beasts and birds, derive from different species of these animals an important supply of food.

If we should be inclined to question which is greater, the good or the evil of which they are the unconscious instruments, we must not limit our attention to one species, one country, or one period, but let our views be wide, comprehensive, and unprejudiced, ever bearing in mind, that after all, we only "know in part," and "see as through a glass darkly." And this considered, we shall probably arrive at the conclusion, that here, as in all other departments of nature, so far as we are capable of observing, there springs

"From partial evil universal good."

In concluding our notice of Rodent animals, we may briefly refer to one or two well known species. Professor Bell remarks, in treating of the Common Squirrel of England (*Sciurus vulgaris*): " The form and habits of this elegant and active little creature combine to render it one of the most beautiful and entertaining of our native animals." In Ireland we are debarred from the opportunity of witnessing its gambols; for in that country it is not now indigenous. There is a tradition that the Squirrel was common in Ireland before the destruction of the native woods. " It was re-introduced a few years ago into the county of Wicklow, where it is said to be fast increasing in number;" and it abounds in some places in the counties of Longford and Westmeath. t

The fur of the English and Scotch Hare is well known as valuable to the hatter, while that of the Irish Hare is worthless. It is only of late years that it has been ascertained that the difference is not confined to the fur, but that the two animals are specifically distinct; J and still more recently, Mr. W. Thompson has arrived at the conclusion that the Hare of Ireland is identical with that known as the Alpine, or varying Hare of the Scotch mountains, notwithstanding the great difference in locality and habits. In this opinion Mr. Waterhouse concurs; so that it may now be regarded as an established fact, there are in reality but two species of Hares in these islands.

The Beaver (Fig. 310) is an animal associated in our minds with the wondrous labours and social instincts which it mani-

Thompson's "Report."

f My authority for this fact was the late Miss Edgeworth or to use that name by which her memory is endeared to the young, "Maria Edgeworth."

J Bell's British Quadrupeds. Thompson on the Irish Hare. Transactions of the Royal Irish Academy, vol. xviii.

feasts, in the solitudes frequented by the North American hunters. Professor Owen has, however, proved from historic and legendary evidence, the former existence of a species of

Fig. 310. BEAVER.

Beaver (*Castor Europæus*) in the British Islands; besides the still more conclusive proof afforded by the remains of that animal associated with those of other denizens of the forest, the Wild Boar, the Deer, and the Wolf.

ORDER EDENTATA. TOOTHLESS ANIMALS.

A few of the animals belonging to the present order are destitute of teeth. In this respect they resemble the Ant-eater of South America, whose long cylindrical tongue, covered with glutinous saliva, furnishes the means of entrapping its insect prey. But with few exceptions the Edentata cannot be described as toothless, the true characteristic is the absence of teeth from the front part of the jaw, where in the preceding group they were so fully developed.

The present order is composed entirely of foreign species and has been divided into three groups, one represented by the Ant-eater, a second by the Armadillo (Fig. 311), and the third by the Sloth (Fig. 312).

The Armadillos (*Dasypus*) are peculiar to the New World no animals encased in a similar bony covering are found

History of British Fossil Mammalia and Birds.

Fig. 311. ARMADILLO.

MAMMALIA, 409 any other part of the globe. They extend from the banks of the Orinoco, through the whole of South America, and occupy the lower regions of the Andes, to the same elevation as the

Sloths, about 3,000 feet. Their food is partly of animal and partly of vegetable substances and fruits.

One species known as the Giant Armadillo, is more than three feet in length. The others are small in size, and compared with the remains of an extinct species, f now in the Museum of the College of Surgeons, London, are as diminutive as the existing Tortoises, contrasted with the remains of that colossal species already mentioned (ante, p. 294) from the Himalayan mountains.

The Sloths (*Bradypus*), of which there are only four species, are found from the southern limits of Mexico to Rio de Janiero. Their food consists exclusively of leaves and fruits. The Sloth has been spoken of by naturalists of high reputation as disproportioned in its parts, grotesque, imperfect, to whom existence must be a burthen. Such opinions have been exploded by a better knowledge of the habits of the animal. It is not destined to live upon the earth, but among the branches of trees, and not on them like the Squirrel, but under them. These things being known, its supposed defects turn out in reality to be perfections; and all its structural peculiarities but so many new adaptations of the animal frame to new functions, each declaring how presumptuous is man, who in his ignorance dares to question the consummate wisdom and perfection displayed in all the works of Nature.

We are indebted to the kindness of Mr. R. Ball, the zealous
Berghalis and Johnston's Atlas.

f It is fully described by Professor Owen in a separate memoir, and named *Glyptodon*, from the Greek *Glyptos* sculptured, odous tooth. *Dasyus*, from the Greek *dasys* hairy, pous a foot.

J *Bradypus* Gr. *Iradys*, tardy, slow; pous, a foot, being nearly the same as the Latin term *Tardigradus*, slow-paced.

Some of the flesh-eaters being in the habit of rooting for their food, have been termed *Effodientia*, or diggers. These terms are not in all cases descriptive of the habits.

lous secretary of the Royal Zoological Society of Ireland, for the accompanying figure (Fig. 312). It represents the *Unau*, or two-toed Sloth, the first ever seen alive in these countries, and is copied from a prize drawing belonging to that society.

Fig. 312. *UNAU*, OR *TATO-TOED SLOTH*.

"The Sloth," Mr. Waterton remarks, "is the only known quadruped that spends its whole life suspended by his feet from the branches of trees. The Monkey and the Squirrel seize a branch with their fore-feet, and pull themselves up, and rest or run upon it; but the Sloth, after seizing it, still remains suspended; and, suspended, moves along under the branch till he can lay hold of another." The rapidity of the movement is well illustrated by Mr. Waterton in the following anecdote: "One day as we were crossing the river *Esse-qui-bo*, I saw a large two-toed Sloth on the ground upon the bank. How he got there nobody could tell; the Indian said he never had surprised a Sloth in such a situation before; he could hardly have come there to drink, for both above and below the place the branches of the trees touched the water, and afforded

him an easy and a safe access to it. Be this as it may, though the trees were not twenty yards from him,"

This animal formed the subject of a highly interesting Lecture delivered by Mr. Ball at one of the evening meetings of the Society. was published in Saunders's News-Letter April 15, 1844, and gives a general view of the Sloths, recent and fossil.

could not make his way through the sand time enough to escape before we landed. As soon as we got up to him he threw himself upon his back, and defended himself in gallant style with his fore legs. Come, poor fellow," said I to him, if thou hast got into a hobble to-day thou shalt not suffer for it. I'll take no advantage of thee in misfortune. The forest is large enough both for me and thee to rove in. Go thy ways up above, and enjoy thyself in these endless wilds; it is more than probable thou wilt never have another interview with man. So, fare thee well." On saying this I took a long stick, which was lying there, held it for him to hook on, and then conveyed him to a high and stately mora tree. He ascended with wonderful rapidity, and in about a minute he was almost at the top of the tree. He now went off in a side direction, and caught hold of the branches of another tree, proceeding in this manner towards the heart of the forest. I stood looking on, lost in amazement at this singular mode of progress. I followed him with my eyes till the intervening branches closed in between us, and then I lost sight for ever of the two-toed Sloth."

Among the extinct animals of the present order, is one whose massive skeleton has procured for it the expressive appellation of *Megatherium*. Its length, including the tail, must have been more than fourteen feet, and its height upwards of eight feet. The thigh bone was twice the thickness of that of the largest Elephant; the fore-foot must have measured more than a yard in length, and more than twelve inches in width, and was terminated by an enormous claw. The width of the upper part of the tail could not have been less than two feet. Other extinct quadrupeds allied to this in many points of structure have been discovered, and the group deriving a name from its colossal leader, is spoken of as that of the *Megatherioid* animals. Their structure and general habits are most ably treated of by Professor Owen, in a memoir upon one species (*Mylodon robustus*), of which the skeleton is now in the splendid museum of the College of Surgeons, "set up" in the attitude shown in the annexed figure (Fig. 313).

In the course of this volume examples have been adduced of the exercise which the study of natural history gives to

Gr. Mega, great; thērion, a beast.

f Dr. Buckland's *Bridgewater Treatise*. Vide also *Penny Cyclopædia*.

j Gr. mýlē, a mill; odous, a tooth.

the observant faculties, the habits of arrangement which it requires, the generalizations to which it leads, the inexhaustible pleasures which it affords, and the devotional feelings with which it is associated. We would now wish the reader to regard it in a new light, as affording for the reasoning powers a field for their exertion not less beneficial than other

Fig. 313 MYLODON.

departments of science, whose claim to be admitted into our schools and colleges have long since been recognised. As instance of inductive reasoning, we now bring forward Professor Owen's admirable memoir on the *Mylodon*,

"From the structure of the teeth he infers that both the *Megatherium* and *Mylodon* must have been phyllophagous, or leaf-eating animals; whilst from their short necks, the very opposite extreme to the *Camelopard*, they never could have reached the tops of even the lowest trees. Cuvier had suggested that they were fossorial or digging animals. Dr. Lund, a Danish naturalist, had considered the *Megatherium* to be a scansorial or climbing animal; in short, a gigantic sloth. After a multitude of comparisons, Professor Owen rejects the explanation of all his predecessors. He shows that the monstrous dimensions of the hinder parts of the body, and the colossal and heavy hinder legs could never have been designed either to support an animal, which simply scratched the earth for food, or one which fed by climbing into lofty trees, like the diminutive Sloth; and he further cites the structure of every analogous creature, either of burrowing or climbing habits, to prove, that in all such, the hinder legs are comparatively light. What then was the method by which these extraordinary monsters obtained their great supplies of food?"

The bones which correspond with those termed in the human body the hip-bones, were of enormous size, and were conjoined with muscular masses of unwonted force. Professor Owen supposes that the animal first cleared away the earth from the roots with its digging instruments, and that there seated on its hinder extremities, which, with the tail, are conjectured to have formed a tripod, and aided by the extraordinary long heel as with a lever, it grasped the trunk of the tree with its fore-legs. Heaving to and fro the stateliest trees of primeval forests, and wrenching them from their hold, he at length prostrated them by his side, and then regaled

They form the family *Gravigrada*, "heavy paced," of Owen. There is scarcely a doubt, that the tail of the *Mylodon* was supplied with an arrangement of arteries similar to that which is known to exist in the arm of the Sloth, and which serves to enable the animal to maintain without fatigue his position, when suspended from the branch of a tree. This is confirmed by the discovery by Dr. Allman, of a similar arrangement in the tail of the *Armadillo*; and it is known that this animal can stand for a short time tripod-like, upon the tail and hind legs. Mr. Ball, in the lecture referred to, regards this arterial arrangement as typical of that which must have existed in the *Megatherioid* animals.

VOL. II. K himself for several days on their choicest leaves and branches, which till then had been far beyond his reach."

The theory thus proposed is, as Professor Owen remarks, "strictly in accordance with, as it has been suggested by, the ascertained anatomy of the very remarkable extinct animals, whose business in a former world it professes to explain;" and he sums up his reasoning in the following words: "all the characteristics which exist in the skeleton of the *Mylodon* and *Megatherium*, conduce and conquer to the production of the forces requisite for uprooting and prostrating trees, of which characteristics, if any one were wanting the effect would not be produced"

ORDER RUMINANTIA. RUMINATING ANIMALS.

" Mightiest of all the beasts of chase,

That roam in woody Caledon, Crashing the forest in his race,

The mountain Bull comes thundering on.

"Fierce on the hunter's quiver'd band, He rolls his eyes of swarthy glow, Spurns with black hoof and horn, the sand, And tosses high his mane of snow."

SCOTT'S CADYOW CASTLE.

"THE order Ruminantia is distinguished from all the other orders of mammalia, by the existence of four stomachs, arranged for the act of ruminating or chewing the cud. These animals are essentially herbivorous, and are all possessed of the cloven hoof; and it is only among them that species are met with whose foreheads are armed with horns. This order, which is one of the most natural and best defined! of all the i The substance of Professor Owen's Memoir on the Mylodon, has been so ably abstracted by Sir R. I. Murchison, in his address as President of the Geological Society, 1843, that we have, as far as possible, availed selves of the language employed by that eminent geologist.

f This opinion, though expressed by Cuvier and generally received, been called in question by Professor Owen, from evidence principa afforded by his researches into the structure of extinct species of Ru nantia and Pachydermata.

primary groups into which the mammalia have been divided, is principally represented by the Ox, the Sheep, the Goat, and the Deer; but it is usual also to classify with them the Giraffe, Camels, Antelopes, Llamas, c. They are subdivided into nine genera, comprising in all one hundred and forty-eight species, forming about one-tenth of all the mammalia. Following the general law of distribution, the Ruminantia are most numerous in equatorial regions; but, as if created expressly for the use of the human family, they are distributed over all latitudes in the northern hemisphere, at least from the equator to the regions within the arctic circle; so that, wherever man is found, he is accompanied by those animals most necessary for the supply of his wants and comforts, and most conducive to his progress in arts and civilization. From them he derives a considerable portion of his food and clothing, whether in a savage or a civilized state of society. Their milk, their flesh, their wool, hides, horns, and hoofs, are all converted to his uses; whilst from many of them he derives the most valuable assistance in the labours of the field, and in the transport of commodities. Thus the Rein-deer (Fig. 314), as is well known, forms the chief comfort and the principal means of subsistence to the Laplander; and the Yak or Kash-gow, confers similar benefits on the inhabitants of Tibet and Pamir."

From this general distribution of the Ruminating animals,

The following table is extracted from that given by Mr. Waterhouse in Berghalis and Johnston's Physical Atlas: 1. (Camelus) Camels 2 2. (Aucjienia) Llamas 3 3. (Moschus) Musk Deers 7 4. (Cervus) Deers 38 5. (Camdopardalis) Giraffes 2 6. (Antilope) Antelopes 48 7. (Capra) Goats 14 8. (Ovis) Sheep 21 9. (jbos) Oxen 13

Total number of species 148 128 species belong to the Old World; 23 only to the New.

the continent of Australia must be excepted; among the peculiar Fauna of that country, as well as in Madagascar,

Fig 314. REIN-DEER.

New Guinea, and the greater number of the South Sea Islands, no species of this order has yet been discovered.

Whether the foot is cloven as in the Deer (Fig. 315), and other animals of the present order, or encased in a solid hoof as in the Horse (Fig. 316), it is equally unfitted to assist in the capture of living prey, and the food consequently consists of vegetables. The molar teeth, as might be expected, are so formed as to be peculiarly efficient instruments for the mastication of such substances; and we learn from Fig. 315. Fig. 316. Professor Owen, that "not only orders and genera, but even species, are characterised by

While these sheets were passing through the press, remains of the Rein-deer were discovered near Dublin, associated with those of the Great Irish Deer. The; had previously been found both in Devon and Norfolk; there can therefore be n doubt that the Rein-deer was at one time an inhabitant of these countries. Owen's Fossil Mammalia. Oldham in Journal of Geological Society of Dublin, Nov. 1847.

the various patterns which result from the various forms, directions, and proportions in which the enamel and cement alternate with the dentine," or substance of the teeth, in the crowns of the complex molars.

In the brief notice here given of the ruminating animals, the facts relating to their geographical distribution are given on the authority of Mr. Waterhouse, and occasionally in his words. Some well known example is adduced of each of the nine groups enumerated by that eminent naturalist.

I. (Camelus). " The Arabian Camel (Djomal of the Arabs), from which the Dromedary is only distinguished by higher breeding and finer qualities both being possessed of only one hump is a native of Asia, where, from the earliest ages to the present day, it has formed the chief means of communication between the different regions of the East. Its present geographical distribution extends over Arabia, Syria, Asia Minor, to the foot of the Caucasian chain, the south of Tartary, and part of India. In Africa, it is found in the countries extending from the Mediterranean to the Senegal, and from Egypt and Abyssinia to Algiers and Morocco. It is also very abundant in the Canary Islands."

"After the conquest of Granada, the Arabian Camel was introduced into Spain, by the Moors, and at that time it was abundant in the southern provinces, but as a species it is now extinct. The only place in Europe where this Camel is now reared is at Pisa."

II. (Auchenia). The Llamas, which have been justly termed the " Camels of the New World," diifer from the former from being of smaller size, and in the absence of the hump. They belong exclusively to South America, and chiefly to the western part of the great chain of the Andes. Unlike their Old World relatives who inhabit " Araby the blest," and other sunny regions, the Llamas are found amid the bleak and rocky precipices bordering on the limit of perpetual snow. Owing to the low temperature of Patagonia, they approach the vicinity of the sea. " From this they spread over the elevated regions of the Andes, and in large herds attain, on Chimborazo, the limit of perpetual snow, which there reaches a height of 15,800 feet."

Odontography, p. 527.

f The Camel with two humps is regarded only as a variety, not as a distinct species.

III. (Moschus). The Musk Deer are so called from the species whence the substance called "musk" is derived. They are all distinguished by the absence of horns. Their habitat is the mountains of Central and Southern Asia.

IV. (Cervus). The Deer combine in the highest degree, the characteristics of elegance of form, grace, and fleetness. The Elk or Moose Deer of America (*Alces palmata*), exceeds in size any species now living. It was, however, much surpassed by that extinct species known as the "Irish Elk," and especially as regards the size of the antlers. In the Moose, the span of the antlers between the extreme tips is four feet; in the extinct Irish species, it is eight feet, and the vertebrae of the neck are proportionally larger, so as to bear the weight of the head and its massive appendages. The name of Irish Elk is objectionable, as the animal was not an Elk but allied to the Fallow Deer; and also as the remains are not peculiar to Ireland. They have been met with both in the Isle of Man and in England. In the latter country they are found associated with the fossil remains of a Mammoth, a Rhinoceros, and other extinct mammalia of which they had been contemporaries. t

Of the three species of Deer which are at present living in these countries, the Fallow Deer (*Cervus dama*), is that which is the common denizen of the parks. The Red Deer (*C. elaphus*) which is the largest species, still exists in numbers amid the solitude of the Scottish mountains, and is not quite extinct in some retired localities in Ireland. J The Roebuck (*C. capreolus*), which is smaller than either of the other two, is unknown in Ireland and rare in England, but is yet to be found enjoying a wild life among some of the wooded mountains of Scotland.

V. (*Camelopardalis*). The Giraffe or Camelopard (Fig. 317), of which only two species are known, is confined to the continent of Africa. It browses upon the foliage and tender shoots of trees, and has a tongue so constituted as to serve as an instrument for pulling them down, as would be done by the proboscis of the Elephant.

VI. (Antelope). The traveller among the Alps or the It now forms the representative of a distinct sub-genus, and is named *Megaceros Hibernicus*, from the Greek *mega* great, *ceras* a horn. t Owen on British Fossil Mammalia, j Thompson's Report on the Fauna of Ireland.

Pyrenees, describes one species of this group, the Chamois, and the poets of eastern countries have celebrated the praises

Fig. 317. GIRAFFE.

of another, the Gazelle (Fig. 318). They may be regarded as holding their headquarters in Africa.

That continent alone has thirty-four species of Antelopes, while Asia has ten, Europe two, and America only one. The

Deer and the Antelopes together, comprise more than half of all the existing species of ruminating animals.

VII. (*Capra*). The Goats also are inhabitants of Alpine regions; but while in this respect they agree with the Antelope, their favourite

Fig. 318. GAZELLE.

' Her eye's dark charm 'twere vain to tell, But gaze on that of the Gazelle, It will assist thy fancy well; As large, as languishingly dark." BYRON.

tracks are in a different quarter of the globe, for the greatest number of species is found in Asia.

VIII. (Ovis). " Sheep, the most ancient of our domestic animals, may be traced originally to the countries of Western Asia. They herd in flocks in a wild state on the inaccessible mountainous districts of Asia, Europe, Africa, and America."

The elevation at which some of these creatures habitually live is very remarkable, and to the zoologist a subject of philosophic interest. The Chamois is found between the upper limit of the trees, and the line of perpetual snow, which in the Alps is 8,900 feet; and is 700 feet less on the northern than on the southern declivities of these mountains. The Goat of Cashmere browses on the comparatively naked table-lands of Thibet, at a height of from 10,000 to 13,000 feet above the level of the sea. The Pamir Sheep or Rass (*Ovis polii*), lives at the still greater height of 15,600 feet in the tableland of Pamir, eastward of Bokhara; and the Burrhel (*Ovis lurrhel*) inhabits the highest ridges of the Himalayan chain, where it is described as "bounding lightly over the incrustated snows, at an altitude where its human pursuers find it difficult to breathe."

Fig. 319. BISON.

IX. (Bos). The present group may be represented by our domestic Oxen, which have ever been associated with the field labours and the domestic comforts of man. But the species most celebrated, are probably the ferocious Buffalo of Southern Africa, and the Bison (Fig. 319), which roams in vast herds over the trackless prairies of America,

The extinct animals of this tribe afford another example of the manner in which the historian and the naturalist may at times assist each other's researches. The Romans, when they first penetrated the wilds and forests of uncivilized Europe, discovered two kinds of gigantic oxen. That which they distinguished by its shaggy coat and mane, may be recognised in the still untamed Aurochs of Lithuania. The other is described by Cesar as being "not much inferior to the Elephant in size, and though resembling the common Bull in colour, form, and general aspect, yet as differing from all the domestic cattle in its gigantic size, and especially in the superior expanse and strength of its horns"

Remains of both these species have been found in England in the same deposits and localities; and it is most satisfactory, as Professor Owen remarks, "to find such proof of the general accuracy of the brief but interesting indications of the primitive mammalian fauna of those regions of Europe, which may be supposed to have presented to the Roman cohorts the same aspect as America did to the first colonists of New England."

PACHYDERMATA. THICK-SKINNED ANIMALS.

' Beside him stalks to battle,

The huge earth-shaking beast The beast on whom the castle

With all its guards doth stand; The beast who hath between his eyes The serpent for a hand."

MACAULAY'S LAYS OF ANCIENT ROME. J

THE animals of the present order are, in their general habits, herbivorous. One of their most obvious characteristics is the

Owen's Fossil Mammalia.

f A third species of smaller size has been found in England (vide Owen, p. 508), it has also occurred in Ireland. R. Ball, "Proceedings of the Royal Irish Academy," January, 1839.

J The author states in a note that Angmmanu, or snake-handed, is the old Latin name for an Elephant. Lucretius ii. 538, v. 1302. VOL. ir. K toughness and great thickness of the skin, as manifested in the Hippopotamus (Fig. 320) and other species. Hence the name Pachydermata, signifying thick-skinned, is that by which they have "been designated.

The order contains but nine genera, divided into thirty-nine or forty species, and comprises the most gigantic of all living quadrupeds. They are found chiefly in the countries of the torrid zone. No animal whatever belonging to this order is found in Australia.

Fig. 320. HIPPOPOTAMUS.

The Indian and the African Elephants are distinct species and these terms point out the countries in which they are indigenous. The Hippopotamus or "River-horse," whose bulk is scarcely inferior to that of the Elephant, is peculiar to Africa, and even to certain districts of that continent. There are no less than seven species of Rhinoceros, which are distributed through both Asia and Africa. Of the group of which the Swine is the representative, the Wild Boar only is found in any part of Europe. The Wart Hogs belong solely to Africa, and the Peccaries to America. The Tapirs, which are distinguished from all other animals by their prolonged and flexible snout (Fig. 291) are common to both the Old and the New World.

The Horse is universally distributed, either in a wild or domesticated state. Fossil remains of a species distinct from

They are thus enumerated by Berghaiis and Johnston: Elephants, 2 species. Damans, 3 species. Peccaries, 2 species. Hippopotamus, 1 Swine, 9 Tapirs, 3

Rhinoceros, 7 Wart Hogs, 3 Horses, 9 t It is generally considered that there are at least two species.

any now existing have been found both in North and South America. This circumstance has elicited from Mr. Darwin the remark "It is a marvellous event in the history of animals, that a native kind should have disappeared, to be succeeded after ages by the countless herds introduced with the Spanish colonist." The wild Asses extend from Siberia to Egypt; and the different species of Zebra (Fig. 321) throughout central and southern Africa, some inhabiting the plains, others selecting the mountains.

Fig. 321. ZEBRA.

Having briefly given the geographical distribution of the leading groups of the present order, we turn to the Elephant, the "half-reasoning Elephant," as he has been termed by the poet. We do so, not for the purpose of bringing forward anecdotes illustrative of his strength, docility, or sagacity; his inoffensive habits, or his utility to man; but that we may advert to certain peculiarities of structure, and to the interest which attaches to him in reference to species which have passed away, but which have left scattered over Europe the memorials of their former existence.

The food of the Elephant consists not merely of leaves, but of the twigs and branches of trees. It is needful, therefore, that he should have teeth fitted to grind down the

woody fibre, and with some principle of renovation which would make up for the continual wearing away. The teeth are composed

Voyages of the Adventure and Beagle, vol. iii, p. 150.

of three substances of different degrees of hardness; the "dentine," which constitutes the principal component; the "enamel," which is a much harder substance; and the "cement," which is a softer one, and serves to unite the plates of which the tooth is composed. The unequal density causes the surface to wear away in an unequal manner, and hence the property which makes a mill-stone most valuable is secured. The arrangement to make good what a mechanic would call "the wear and tear" of the apparatus is not less effectual. The teeth are ever growing, not as in the Rodentia

Fig. 322. INDIAN ELEPHANT.

(ante, p. 404), by a deposit of new matter at the base, but by the development of new teeth. We are accustomed to see a new tooth come forth in the mouth of a child from the place where the former tooth had been shed; but in the young Elephant the plan of development and succession is altogether different. Each tooth is formed in a membranous bag, enclosed in a chamber of bone, forming part of the massive jaw. They are successively developed, so that an Elephant may have in each jaw not less than six of these enormous molar teeth in the course of its life, or twenty-four in all, although never more than two are seen in each jaw at the same time. As the first tooth wears away, the second tooth is advancing forward; when the first becomes worn and useless the second tooth takes its place, its former position "being now occupied by the third tooth, which in course of time is carried forward to the front of the mouth, serves its distinct purpose, and when worn down is succeeded by that which was the fourth.

"There are few examples of natural structures," says Professor Owen, "that manifest a more striking adaptation of a highly complex and beautiful structure to the exigencies of the animal endowed with it, than the grinding teeth of the Elephant. Thus the jaw is not encumbered with the whole weight of the massive tooth at once, but it is formed by degrees as it is required; the sub-division of the crown into a number of successive plates, and of the plates into sub-cylindrical processes, presenting the conditions most favourable to progressive formation." Another advantage is pointed out by the same high authority: "The tooth in front, which is partially worn down, is fitted for the first coarse grinding of the branches of a tree; the transverse enamelled ridges of the succeeding part of the tooth divide the food (as it passes on towards the throat) into smaller fragments, and the posterior islands and tubercles of enamel pound it to the pulp fit for deglutition."

It may readily be supposed that the number and thickness of the plates, the shape of the teeth, and the different patterns in which the enamel is arranged, form characters by which the teeth of the same species in different stages of maturity may be recognised, and that they also furnish the means of separating those of the African from the Asiatic Elephant; and both of these from that extinct species known as the Mammoth (*Elephas primigenius*).

The teeth of the Mammoth, which are thus easily distinguishable, are found in the superficial unstratified deposits of the continent of Europe; and with them are

associated the remains of two other animals, belonging to the present order, and now found only in warmer latitudes the Hippopotamus and Rhinoceros.

On British Fossil Mammalia.

When such statements were first made by Cuvier, it was no wonder they were received with incredulity; and that even when they were admitted, reference should be made to the Elephants introduced by Phyrus in the Roman wars, and to the stranger quadrupeds from conquered countries, as explanatory of their occurrence. But their abundance proved that such a cause was insufficient for the effect; and when it was shown that they were equally plentiful in England, where many living Elephants were not likely to have been introduced, and that they had also occurred in Ireland, where a Roman legion never encamped, there was no alternative but to admit that those huge quadrupeds must have inhabited the countries in which their remains had been discovered.

Professor Owen, in his work on the fossil mammalia of Britain, gives descriptions and illustrative figures of the remains of the Mammoth,¹ of a large Hippopotamus, two species of Rhinoceros, and one of a Mastodon, an animal equal in bulk to the Elephant, and, like it, furnished with tusks and a flexible proboscis. These mighty quadrupeds once ranged over tracks which are now occupied by the busy towns, the verdant plains, and 'The stately homes of England.'

Their bones, too, are sometimes found "full fathom five" in the seas that encircle her shores; and the trawling-net of the fisherman, when it encounters their heavy mass, has been known to break under its burthen. "Such occurrences," as the Professor well remarks, "recall to mind the adventures of the fishermen narrated in the Arabian Nights; but the fancy of the eastern romancer falls short of the reality of this hauling up, in British seas, of Elephants more stupendous than those of Africa or Ceylon."

The occurrence in Ireland of the molar teeth of an Elephant was made known by Neville and Molyneux, in 1715.

f The entire carcass of a Mammoth was discovered in 1799, among the blocks of ice at the mouth of the river Lena, in Siberia; and so perfectly had the soft parts of the body been preserved from decay by their icy covering, that the flesh, as it became exposed, was devoured by wolves and bears. It was clothed with a double garment of close fur and coarse hair, some of it sixteen inches in length, and by means of this thick shaggy covering, was specially adapted for living in that climate. The animal was a male, with a long mane on the neck, The skeleton is set up in St. Petersburg.

u Part huge of bulk,

Wallowing unwieldy, enormous in their gait, Tempest the ocean: there Leviathan, Hugest of living creatures, on the deep. Stretch'd like a promontory, sleeps or swims, And seems a moving land." MILTON.

In passing from one order of mammalia to another, the scene changes like that of a panorama. From the Pachydermata, living on the land beneath the burning sun of India or of Africa, we turn to the Cetacea, dwelling in the seas, and fixing their head quarters

"In thrilling regions of thick-ribb'd ice."

These animals are distinguished by their fish-like form their flat horizontal tail and by the anterior extremities being in the form of fins. They were divided by Cuvier

into two families, the herbivorous and the carnivorous, according to the nature of their food. The carnivorous Cetacea, to which our attention shall be restricted, are arranged in three groups, represented by the Dolphin, the Spermaceti Whale, and the Baleen Whale, in all of which the nostrils are situated on the crown of the head, and act as blow-holes.

Delphinidae. The common Dolphin (*Delphinus delphis*) is occasionally met with on our coasts. The very name is associated with classic fable, "and with the splendid creations of our own Shakspeare; and its habits are such as to excite universal interest whenever they are observed. "The excess-

Avion having charmed the Dolphins by his music, was carried by one of them on its back. Amphitrite's car is represented as drawn on the sea by a group of Dolphins.

f The passage referred to is that in the *Midsummer Night's Dream*:

"I sat upon a promontory,

And heard a Mermaid, on a Dolphin's back Uttering such dulcet and harmonious breath That the rude sea grew civil at her song."

sive activity and playfulness of its gambols, and the evident predilection which it evinces for society, are recorded by every mariner; numerous herds of them will follow and surround a ship in full sail, with the most eager delight, throwing themselves into every possible attitude, and tossing and leaping about with elegant and powerful agility, for no other apparent reason than mere pastime."

The common Porpoise (*Phocena communis*, Fig. 323) is

Fig. 323. PORPOISE.

scarcely less playful or less sociable. It is the most common species of Cetacea around our coasts, entering our bays in pursuit of shoals of Herrings and other fish, and attracts attention by the manner in which it rolls over, as it comes to the surface to breathe. A herd of them may be sometimes seen, indulging in their unweildy gambols, and chasing each other in sport. "On the approach of a storm, or even in the midst of the tempest, they appear to revel in the waves, showing their black backs above the surface, and often throwing themselves wholly out of the water in their vigorous leaps." The length of the body is from four to six feet.

To the same group belongs the Bottle-head Whale (*Hy-peroodori*), occasionally taken on our shores; the Round-headed Porpoise or Caaing Whale (*Phocena melas*), which appears in herds of several hundreds; and the Narwhal (*Monodon monoceros*), whose single projecting tooth, six feet or more in length, has procured for it the name of Sea-Unicorn.

Physeteridae. "The common Cachalot, or Spermaceti Whale, is well known," says Professor Bell, "as affording that peculiar and useful substance from which it takes its common name. The enormous size of the head, in length very nearly equalling, and in its bulk even surpassing, half of

Professor Bell's *History of British Quadrupeds*; from this work we have enriched our brief notice of the Cetacea with several extracts, the whole animal, is principally dependent upon the immense quantity of spermaceti, which is contained in a thick dense bag, divided into compartments, and placed in the front part of the head. This substance, which exists in a fluid state in the living animal, is also found along each side of the back, and in some other parts of the body.

The Cachalot reaches the length of seventy feet. In its enormous bulk, therefore, it equals or even surpasses the common or Baleen Whale. Its strength is enormous. A single blow of the tail will dash a boat to pieces; " and there is a well-known authenticated instance on record, of an American ship of large size being stove in and foundered by the blow inflicted by the head of an infuriated male Cachalot of large size." Though small fishes have been found in its stomach, its principal food is Cuttle-fish.

The Common Whale (*Balcena mysticetus*, Fig. 324) feeds,

Fig. 324. BALEEN WHALE.

as is well known, on minute Crustacea, mollusca (ante, p. 175), and medusaa (ante, p. 42). It is so greatly reduced in numbers in the Greenland seas, that Baffin's Bay, Hudson's Bay, and other localities made known by the enterprise of British seamen, are now the principal seats of the "fishery" a term we would gladly change, as it tends to keep up the vulgar and erroneous idea that the Whale is a fish. Its affection to its young, its importance to man, and the dangers incurred in its pursuit, are attractive subjects; but instead of entering upon their consideration, we prefer devoting our limited space to points of structure exhibited in the Whale, and with some modifications found throughout all the animals of the present order.

The position of the tail in Whales is horizontal; in fishes it is vertical (ante, p. 220); and the adaptation in each instance is admirably fitted to the wants of the animal. For fishes it is used as an instrument for progression in the water, and they may speed onwards in their course at nearly the same uniform depth. But by the very nature of their organization, Whales are compelled to rise to the surface for each respiration; and as the tail is horizontal, it acts as an oar of inconceivable power; its superficial measurement in the larger species being not less than one hundred feet.

"But if this powerful implement be necessary to raise the Whale into contact with the atmosphere, the immense depth of water from which he is thus raised implies a superincumbent pressure so immense as to require some extraordinary condition of the body to prevent its absolute destruction. The most obvious means for meeting this enormous pressure, which in most cases must amount to 154 atmospheres, or about a ton upon every square inch, is a thickening of the integument, or the production of some incompressible substance, which shall invest the whole animal: and we find this object to be effected in a manner which must excite the greatest admiration, "t Professor Jacob, of Dublin, J has shown that the structure in which the oil is deposited, and which is called "blubber," is the true skin of the animal, modified for the purpose of holding this fluid oil, but still the true skin. It consists of an interlacement of fibres, crossing each other in every direction, as in common skin, but more open in texture, to leave room for the oil. A soft wrapper of fat, like that of the Hog, would not have answered the purpose. " Though double the thickness to that usually found in the Cetacea, it could not have resisted the superincumbent pressure; whereas, by its being a modification of the skin, always firm and elastic, and in this case being never less than several inches, and sometimes between one and two feet thick, it operates like so much caoutchouc, possessing a density and resistance whicli the more it is pressed it resists the more."g

Some of the larger species can remain under water for a considerable time. Vide Naturalists' Library, vol. vii. or article "Cetacea," Encyclopedia of Anatomy and Physiology.

f Bell.

J Dublin Philosophical Journal, i. p. 356, quoted by Bell.

Naturalists' Library, vol. vii. quoted by Bell. Above a year before we

This remarkable structure has another use; it acts like a blanket, and, being a bad conductor of caloric, prevents the animal heat from being dissipated, thus enabling these warmblooded inhabitants of the sea to resist the cold of the medium in which they live. Nor does its utility stop even here; it is specifically lighter than the sea-water, and though its weight sometimes exceeds thirty tons, it does not act as an incumbrance, but in reality renders the animal more buoyant.

Thus provided, the Rorqual, of ninety or a hundred feet in length, the largest of all Whales, and consequently of all existing animals, can propel its enormous bulk through the water, or float at ease upon the surface. To such a being how appropriate and how beautiful are the words of Milton: - "That sea-beast

Leviathan, which God of all his works Created highest that swim the ocean stream: Him, haply, slumbering on the Norway foam, The pilot of some small night-founder'd skiff, Deeming some island, oft, as seamen tell, With fixed anchor in his scaly rind, Moors by his side under the lee, while night Invests the sea, and wished morn delays."

PARADISE LOST. Book I.

met with this extract, we had an opportunity of examining a Hyperoodon, or Bottle-head Whale, taken in Belfast Bay. One of the captors had inflicted a wound on the back with a hatchet, and the dark skin and light coloured blubber underneath we could compare to nothing but a newly-cut cake of caoutchouc. In firmness and elasticity, when pressed by the finger, the resemblance seemed not less perfect.

It is almost needless to say that the skin is not "scaly." In the works of Gesner, 1588, there is the figure of a vessel anchored to a Whale; so that the poet has given expression to what was at one time the current belief.

- "The Tiger darting fierce Impetuous on the prey his glance has doom'd;

The lively, shining Leopard, sparkled o'er

With many a spot, the beauty of the waste,

And scorning all the taming arts of man." THOMSON.

IN this order Cuvier included insect-eating animals, whether like the Bat they pursued their prey in the air, or like the Hedgehog sought for it on the earth. But each of the animals just named is now the representative of a distinct order, and the term carnivora is restricted to those which live principally upon the flesh of other vertebrate animals, and in popular language are termed beasts of prey.

Taking the family of the Tiger as that in which the characteristics of the order are most fully developed, we find strong retractile claws, and teeth (Fig. 325) eminently fitted for cutting and tearing flesh. In that of the

Bear, the light elastic step has given place to a heavy gait, and the teeth are adapted for a diet consisting partly of flesh and partly of vegetables. In the seals, which are aquatic carnivora, the body is fish-shaped, and the extremities are modified in

form, and present the appearance of paddles, fitted to propel the animals with velocity through the water, in pursuit of their finny prey.

The order presents, therefore, great diversity of form among its members, and includes a considerable number of species. They amount, according to Berghaus and Johnston, to 239,

They walk upon the sole of the foot; and the term Plantigrade, planta, a sole, gradus, a step, has therefore been applied to all which prog in that manner. The cat and others walk on the extremities of the to and are hence grouped under the term Digitigrade, Lat. digitus, a fing gradus, a step.

which are widely distributed, but are in general most abundant in tropical countries. They have been arranged in five families. 1. Phocidæ. The first is that of the Seals (Fig. 326). Like the cetacea, they are warm-blooded mammalia, living in the sea; but they are at once distinguished from them by the absence of the broad, flat, horizontal tail, the presence of the

Fig. 32G. SEAL.

four fin-shaped feet, and other peculiarities. Their great haunt is the sea of the arctic regions, and the fishery, for so it is termed, is one of great value, both for the oil and the skins. The number of Seals annually taken has been estimated at the extraordinary number of one million.

Four species are known on the coasts of these countries. f The most common (*Phoca vitulina*) appears to be of a docile and gentle disposition; its most usual length is from four to five feet. Other species are said to attain a length of fourteen or fifteen feet.

II. Ursidæ. The Bears are remarkable for their great strength, their ponderous body, and their peculiar gait. The food of the American Black Bear is principally vegetable; f that of the Polar Bear is flesh, mostly that of the Seals. The

Berghaus and Johnston's Physical Atlas.

f For details respecting their appearance and habits, vide Professor Bell's British Quadrupeds; R. Ball on the Phocidæ of the Irish Seas, Transactions of the Royal Irish Academy, 1838. We would add Maxwell's Wild Sports of the West.-Those who have read Sir Walter Scott's Antiquary do not require to be reminded of the encounter of Hector M'Intyre and the "Phoca."

J The fondness of this animal for honey is so well known, that Washington Irving, in his Tour on the Prairies, introduces one of the rangers as expressing himself in the following graphic, though not very elegant phraseology: "The bear is the knowingest varmint for finding out a bee-tree in the world. They'll gnaw for days together at the trunk, 'till they make a hole big enough to get in their paws, and then they'll haul out honey, bees, and all."

Brown Bear (Fig. 327) is found in the mountainous parts of the Continent of Europe, and was formerly a native of Britain, The remains of two other species have been discovered in England, as well as in other parts of Europe, in a fossil state; one of them, the Great Cave Bear, must have been of gigantic size.

Fig. 327 BROWN BEAR.

The Badger (*Meles taxus*) is in these countries the only surviving representative of the present family. Fossil remains of the Badger have been found in the same

localities as those of the Great Cave Bear above-mentioned; and the species appears to be identical with that existing. There are even grounds for attributing to it a still higher antiquity, and for believing it to be, to use the words of Professor Owen, "the oldest sped of mammalia now living on the face of the earth."

III. Mustelidæ. The Otter, the Weasel, and the Ferret are so well known that they may be enumerated as giving, by the slenderness and flexibility of their bodies, an idea of the characteristic structure of the group. The Otter, which lives principally upon fish, has been taught to aid the fisherman in his vocation. The Stoat (*M. erminea*), like the Alpine Hare or the Ptarmigan, changes the colour of its covering in winter to a snowy white. The fur is then in that condi-

British Fossil Mammalia, p. 111.

tion in which it is most valuable, the pure white of the skin contrasting with the deep black colour of the tail. Its unsullied aspect has even become proverbial; in so much that the "ermine robe of justice" is regarded as symbolical of the mental purity of its wearer. The Ermine has been observed among the Swiss mountains at an elevation of 9,600 feet; its habitation is above the lower limit of perpetual snow, and in the region of the Alpine shrubs.

IV. Canidæ. The various races of the domestic Dog, in all climates the friend and companion of man, belong to this family, and also the Fox and the Wolf. The Fox would probably have ceased to exist in these countries, but for the protection afforded to him by the sportsman. The Wolf (Fig. 328), less cunning and more fierce, has long since been

Fig. 328. WOLF.

exterminated. Professor Bell inclines to the opinion, "that the Wolf is the original source from which all our domestic dogs have sprung, t"

V. Felidæ.-The Cat tribe includes the Lion, the Tiger, the Panther, the Leopard (Fig. 329), the Puma, and those other quadrupeds remarkable for their destructive powers. They serve to keep within bounds the excessive multiplication of the smaller mammalia, and are widely distributed. The Wild Cat is now the only representative of the group in these countries.

There was a period, however, when a Tiger larger than that of Bengal, and with proportionally larger paws, roamed over Europe. Its remains have been found in England, and Professor Owen speaks of it as the "Great Cave Tiger."

Berghaui and Johnston. f British Quadrupeds, p.

To the Very Rev. Dr. Buckland, Dean of Westminster, we owe a detailed account of a discovery even more interesting:

Fig. 329. LEOPARD.

that of a cave at Kirkdale, in Yorkshire, which had been inhabited by Hyænas. These animals are now met with only in Asia and Africa; the species represented in the figure (Fig. 330), is found at the Cape of Good Hope. They live principally upon carrion, thus presenting the same analogy to the Tiger that the Vulture does to the Eagle. They also devour the remains left by other beasts of prey, and crunch the bones, which they are enabled to do by the great strength of their jaw; The teeth of Hyænas found in the cave at Kirkdale, give evidence, Dr. Buckland states, of the existence of two three hundred individuals. They belonged to an extinct species first made known

by Cuvier, and exceeding in size the largest species of Tiger. The whole extent of the floor Kirkdale cavern was strewn with bones of different animal

Reliquiae Diluvialiae.

of the imals, broken and splintered, and bearing evidence of the action of jaws which, even in the more diminutive species at present existing, are known to be sufficiently powerful to bite off the leg of a dog at a single snap. From the facts which his researches elicited, Dr. Buckland infers, that the cave must have been for a long series of years the residence of Hyamas, and that they dragged into its recesses the other animal bodies, the remains of which are found mixed indiscriminately with their own.

It is a strange tale that within the caves of Yorkshire, and other English localities, those powerful beasts had dwelt, and at night had roamed abroad and sought their prey; and no less strange are the facts brought to light by the examination of the remains of those animals on which they fed. They consisted of the Great Cave Bear and Tiger, the Mammoth, Rhinoceros, Hippopotamus, the " Irish Elk," wild oxen of colossal size, and other mammalia belonging to an extinct Fauna.

We speak of the brevity of life, but our language applies to the life of an individual. Let us expand our thoughts and reflect on the brevity of life, assigned, not to an individual, but to a species. Here several quadrupeds are named, all large and powerful, yet not one of them has left a descendant among living tribes. f They lived their appointed time, performed their allotted work, then passed away, and have been succeeded by other species whose structure is no less perfect, and who fulfil no less efficiently what is given them to do.

The question naturally arises how the various members of the ancient Fauna came into one small island? The answer given by those who have most attentively studied the evidence bearing upon the subject, is that these countries were not at that time separated from the continent of Europe. The geological structure, the fossil remains, and the existing Flora, all testify the same fact, and render the conclusion irresistible, f

Of what geologists call " the newest tertiary and drift periods." f Mr. Lyell was the first to make known the remarkable fact, that the " longevity of the species in the mammalia, is upon the whole, inferior to that of the testacea." Principles of Geology, vol. iv.

J On this subject we would refer to the original and valuable Essay of Professor Edward Forbes, in the first volume of the Memoirs of the Geological Survey of Great Britain; to the Introduction to Professor Owen's Fossil Mammalia; and to an able review of the state of our knowledge upon the subject, in the anniversary address of the President of the Geological Society, Leonard Horner, Esq. F. R. S. 19th Feb. 1847.

VOL. U. L

Fig. 331. TEETH OF AN INSECTIVOROUS ANIMAL.

"Tray you tread softly, that the Blind Mole may not Hear a foot fall." SIIAKS-PEAKE.

THE teeth of the Insectivora, raised into pointed and conical summits, furnish another example of the adaptation of the teeth to the nature of the food on which they

are designed to act. This order is represented among British animals by the Shrew, the Hedgehog, and the Mole.

Soricidae. The general appearance of the Shrew (Fig. 332), is well indicated by its popular name of

"Shrew Mouse." It frequents the field and the garden, rooting with its long and tapering snout for insects and worms. The Water Shrew is not found in Ireland.

Erinaceidae. The Common Hedgehog (*Erinaceus Europaeus*) is, as its scientific name imports, widely distributed over Europe. It is unable to defend itself by force, or to seek safety in flight; yet by its peculiar covering it is "endowed with a safeguard more secure and effectual than the teeth and claws of the Wild Cat, or the fleetness of the Hare." Idle stories of its robbing orchards, and carrying off the apples upon its spines are yet current in Ireland. At the time last heard the tale, the innocent object of the slander was in the house, crunching with much apparent relish, the Common Banded Snail (*Helix nemoralis*), in its shell a group of mer children having collected from about the hedgerows a large plateful of the Snails as a supper for their prickly favourite. **Talpidae.** The Mole (*Talpa vulgaris*, Fig. 333) is no

The species represented is the Musaraigne of the French authors, and according to Professor Bell, identical with the common Shrew of England (*Sorex araneus*).

Fig 1. 332. SHREW.

found in any part of Ireland. It has no external ears, and the eyes are so extremely minute that in popular language it is always spoken of as "blind." The broad forefeet with the palms turned outwards, and so admirably adapted for digging, are the most striking characteristic. The food consists of insects and worms, though vegetable matters are occasionally found in the stomach, because that Moles gnaw the roots of plants for the purpose of extracting larva and worms. They do not become dormant during the winter, so that the necessity of exertion to obtain the needful supply of food is continual.

Fig. 333. MOLE

To the superficial observer, the Mole "blind, awkward, and shapeless," condemned to a life of toil in subterranean darkness is an object of pity. To the naturalist it affords another proof "of the wisdom and beneficence of the Creator, which can render a life so apparently incompatible with comfort, in reality one of almost incessant enjoyment."

"Its feeding and its habitation, its wanderings and its repose, its winter retreat, and the nest in which its young are brought forth and nourished, are all so many calls for the most laborious and enduring toil; but on the other hand, that toil is so amply provided for in the whole structure of the animal, so exactly balanced by the strength and conformation of its limbs, that it cannot be considered as exceeding the healthful, and even pleasurable exercise of its natural powers."

The words we have just quoted are those of Professor Bell; we use them because we would wish to introduce to the reader, the complete and interesting exposition of the habits and economy of the Mole, given by that eminent zoologist, in his History of British Quadrupeds; from that work, by the kind permission of its author, our representation of the animal has been copied.

There is another species, *T. caca*, in which the eyelids are closed; both are inhabitants of Europe.

The bat that with hook'd and leathery wings

Clung to the cave-roof." SOUTHEY'S THALABA, book ix. st. 30.

WHEN we see the Common Bat (*Vespertilio pipistrellus*) flitting about after its insect prey in the dusk of the summer evening, we at once recognise it as an insectivorous animal, adapted for capturing its food in the air instead of on the earth. We then are naturally led to inquire by what means

Fig. 334. SKELETON OF BAT.

t Fig. 334. SKELETON OF A BAT. cl, clavicle; 7i, humerus; CM, ulna; t carpus; o., thumb; me, metacarpus; ph, phalanges; o, scapula; , femur; t tibia. The several bones are indicated by the same letters as in the skeleton of the human arm. What is the mechanism by which the power of flight is given to the Bat? It is furnished with wings. Do they resemble those of the bird? They are altogether unlike, differing not only in the absence of feathers, but in their entire structure. In birds the feathers are principally attached to bones which correspond with those of our arm. But to compare the bones of the Bat's wing with those of the human frame, let us suppose the skeleton of a man with the fore arm gently prolonged, and the fingers about a yard and a-half in length. The bones would then form a framework analogous to that of an umbrella, and capable like it of being shut up or expanded. Let us suppose this bony framework covered with some light and pliant material, which is continued between the legs and down to the ancles, and we would then have a figure resembling in the organs of flight that which is in reality possessed by the Bat, and which is represented in the accompanying figure (Fig. 334). The bones of the fingers constitute the framework of the wing, and hence the term Cheiroptera, or "hand-winged" is that by which the order is designated. The thumb does not partake of this extraordinary development; it remains free, and is furnished with a hooked nail.

If a Bat be placed on the smooth surface of a table, its awkward attempts at walking (Fig. 335), give an idea of helplessness akin to that which was suggested to naturalists when the Sloth was seen upon the ground. Yet compassion in both cases would be alike misplaced. Each animal is gifted with powers of locomotion adapted to its wants. The Bat can climb with ease the rugged and perpendicular surface of a tree, or can wheel its flight in the air, though burthened with one or two young adhering to its teats.

The use of the wings does not seem to be limited to that of flight. They appear to be endued with a most delicate sense of touch, a sense so exquisitely fine as to be affected by the slightest difference in the vibrations of the air. By the Cruel Fig. 335. BAT WALKING.

From the Greek words meaning "a hand" and "a wing."

experiments of Spallanzani, it was proved that Bats deprived of sight could fly without striking against walls or other objects, and were even able to avoid coming into contact with threads placed across the apartments in various directions.

Many tribes of Bats have curious leaf-like appendages upon the nose (Fig. 336), and these are supposed to be organs of a sense of smell not less susceptible. The presence or absence of this leaf-like organ, and its various modifications, supply naturalists with a good external character for distributing these animals into different groups.

In the true Bats which are common in these countries these foliated appendages are altogether wanting.

Only three species of Bats have as yet been recorded as

Fig. 336. HEAD of VAMPIRE. natives of Ireland; while eighteen are known in the sister country. In tropical countries the number is much more considerable, some species living upon insects, and some on fruits. There are in all 219 species.

The teeth of the Vampire Bat are exhibited in the annexed figure (Fig. 337); and with such weapons it is easy to imagine

Fig. 337. SKULL AND TEETH OF THE VAMPIRE how they can inflict a wound and suck the blood. But the powers seem to have been much exaggerated. Mr. Darwin says in speaking of the Vampire Bat of South America, which bite the horses on their withers: "The injury is generally not

Thompson's Report. A fourth is said to have been since obtained, t Fig. 337. a, profile of the head; 5, front view of incisor and canine teeth.

much owing to the loss of blood, as to the inflammation which the pressure of the saddle afterwards produces."

Some Bats are of considerable dimensions. There is one species in the island of Java (*Steropus Javanicus*), the expanse of whose wings is so much as five feet. It is probable that some of the large Indian Bats, with their predatory habits and obscure retreats, may have suggested to Virgil the idea of the Harpies "which fell upon the hastily-spread tables of his hero and his companions, and polluted, whilst they devoured, the feast from which they had driven the affrighted guests."

ORDER QUADRUMANA. MONKEYS.

"Meddling Monkey busy Ape." SHAKSPEARE.

THOSE who have visited a zoological garden, or a well-stocked menagerie, cannot fail to have been amused at the freaks and gambols of the monkeys; and after watching for a time their agile movements and grotesque attitudes, must have been struck with the peculiar formation of the extremities, both of the feet and of the paws. The feet are not shaped like ours, but resemble hands, being furnished with fingers and with thumbs. In fact they do not perform the functions of feet only, but of hands also. Hence that order to which the Monkeys belong, is termed *quadrumana*, or four-handed.

We are not, however, to suppose that every individual belonging to this group, possesses both on hands and feet a thumb which can be applied or opposed to each of the fingers. The American Monkeys, for example, are by this single circumstance distinguished at once from those of the Old World. They have the full power of using the thumbs which are on the feet, but not those which are on the anterior extremities. By such differences, and by those in the dentition, the presence or absence of cheek pouches, and other peculiarities, the order is sub-divided into families, genera, and species.

We shall briefly notice the Lemurs of Madagascar, the Monkeys of America, and those of the Old World.

Voyages of the Adventure and Beagle, vol. iii. p. 25. f Bell's Quadrupeds, p. 9.

"The Lemurs," says Mr. Bennett, "are all natives of Madagascar, and one or two smaller islands in its neighbourhood. We know but little of their habits in a state of nature; but they are said to live in large bands upon the trees, feeding principally

upon fruits; and their conformation renders this account extremely probable. They are almost equally agile with the Monkeys, but are much more gentle and peaceable in their dispositions. " It will be seen, from the accompanying figure (Fig. 338), that both extremities are furnished

Fig. 338. WHITE-FRONTED LEMUR AND ITS YOUNG.

with a thumb, which acts in a direction opposite to that of the fingers.

Gardens and Menageries) vol. i. p. 147.

In this respect they contrast with the Marmozet or Oustiti, one of the American Monkeys, whose thumb, as exhibited in the annexed figure (Fig. 339), acts in a line with the other

Fig. 339. Oustixi.

fingers, and whose nails are particularly sharp and crooked. Its principal habitat is Brazil. Other species, known as Howlers, Spider-monkeys, Weepers, and similar names expressive of peculiarities of structure or habit, are scattered throughout the warmer portions of the American continent. In the midst of the trackless forests lying between the Orinoco and the Amazon, they are particularly numerous, dwelling amid the branches of the trees, and adding insects, lizards, the eggs and young of birds, to their usual food of fruits and vegetables. In many of them the tail becomes an instrument of prehension (Fig. 340), by the aid of which they can pass in security from tree to tree, or swing in full activity suspended from the branches. For all animals which have opposable thumbs upon the feet, but not on the anterior extremities, Mr. Ogilby proposes the term *Pedimana*, or "foot-handed."

The monkeys of the Old World, like those of the American continent, are limited to the torrid regions, and are therefore natives of Asia and of Africa. To this there is only one exception, a colony of the Barbary Baboon (*Papio inuus*) occupying a part of the rock of Gibraltar, and appearing to flourish in the elevated solitude of that mighty fortress.

In Asia there are species which are not only free from molestation, but which have been deified by the Hindoos. " Splendid and costly temples are dedicated to these animals; hospitals are built for their reception when sick or wounded; large fortunes are bequeathed for their support; and the laws VOL. ii. L of the land, which compound for the murder of a man by a trifling fine, affix the punishment of death to the slaughter of a monkey." The species thus referred to, the *Entellus*, or

Fig. 340. WHITE-THROATED SAJOU.

Honuman, though a native of the hot plains of India, is found on the Himalaya Mountains, so far as the wood extends, or to the height of thirteen thousand feet. f

The Monkeys (*Simiadcb*) of the Old World are distinguished, in common phraseology, by the names of Apes, Monkeys, and Baboons: "A division which has the rare advantage, seldom attendant upon mere popular classifications, of being in perfect accordance with scientific principles, founded upon the structure and habits of the animals."

The Baboons have capacious receptacles, or cheek pouches, in which they stow their food. They have on the hinder extremities hard places, or, as they are termed, callosities, which are not covered with hair; the tails are short, or re-

Library of Entertaining Knowledge. Natural History of Monkeys, Opossums, and Lemurs, vol. i. A most entertaining and valuable work, to which we refer the reader for details which are incompatible with our limited plan.

f Berghaiis and Johnston.

cluded to tubercles, and destitute of all muscular power. The Baboons go on all-fours, live among rocks and mountains, and in some cases, when they associate in troops, are more than a match for the fiercest beasts of prey. "They are arranged in two genera (*Papio* and *Cynocephalus*), respectively confined, with one or two exceptions, to the continents of Asia and Africa." "The lofty mountains of Abyssinia and of South Africa are tenanted by numerous troops of these animals (*Cynocephals*), which even appear to prefer the more rigorous climate of these elevated regions, to the hot and sultry forests of the lower plains."

The Monkeys also have cheek pouches and callosities, but their tails are long and muscular, and they are pre-eminently a sylvan race. They walk on all-fours, and their long tails become powerful and efficient instruments in guiding their movements, and in maintaining, like the pole of the rope-dancer, their equilibrium during their rapid and varied evolutions. The face presents in different species a great diversity of colour, being white or black, blue or red, flesh or copper-coloured; and, added to their grimaces and imitative propensities, gives to them in our eyes the fantastic appearance that has become proverbial.

The Apes have neither tails nor cheek pouches; and the callosities mentioned exist only in a rudimentary form, or are altogether wanting. Their pace is semi-erect, and in their native woods they walk on two legs even along the branches, their long arms compensating for the want of a tail in steadying and directing their motions." With the exception of the Chimpanzee of Western Africa (Fig. 341), they are limited to the great islands of the Indian Archipelago. The various anecdotes which are related of the Chimpanzee and the Orang Outan evince on the part of Fig. 341. CHIMPANZEE.

these animals a superior degree of intelligence and docility. In them the philosopher will find the nearest approach to man. Loth in mental characteristics and bodily configuration, which the lower animals are permitted to attain yet vast and impassable is the barrier of separation.

The Monkeys, so far as they are known at the present time, contain in all 170 species, forming the one-ninth of all mammalia. Their fossil remains have been found in France, in India, and in South America. They have also occurred in England; so that there is no doubt that when the climate was suitable for the Crocodiles and Turtles, whose remain³ occur in the London clay, and for the growth of the cocoa-nuts and spices found in the Isle of Sleppy, it was sufficiently warm for these four-handed mammalia, to enjoy their arboreal life among the branches.

To the classical scholar the present order is deserving of notice, as having given origin to the ancient fiction of satyrs, pygmies, and other supposed tribes of human monsters.

ORDER BIMANA. MAN.

'Two of far nobler shape, erect and tall, Godlike erect, with native honour clad, In naked majesty seem'd lords of all; And worthy seem'd; for in their looks divine The image of their glorious Maker shone."

PARADISE LOST.

MilTox, in these lines, has described with the truthfulness of real poetry, one of the most striking external characteristics of Man his erect gait. The zoologist points to the human hand as presenting another mark of distinction. In man only can the thumb be applied with such precision and power to each of the fingers as to seize the most minute objects. So much superior is it to the anterior extremity in Monkeys, that Sir Charles Bell remarks, "We ought to define the hand as belonging exclusively to Man. "t Of all animals, the term Bimana, or two-handed, is applicable to Man alone. He

Owen's Fossil Mammalia, p. 1. f Bridgewater Treatise, p. 18.

Fig. 342. NERVOUS SYSTEM OF MAN.

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SCIENTIFIC TERMS OCCURRING IN THIS WORK.

ACALE'PH E, an order of rayed animals, well known by the name of Sea-nettles. They are remarkable for their gelatinous structure and their stinging powers. From the Greek acalephe, a nettle. ACANTHIOPTERY'GII, an order of fishes, in which the dorsal fins are supported in part by spinous rays. Gr. acanthos, a spine, pteryx a whig or fin. ACE'PHALA, a group of molluscous animals which, like the

Oyster and Scallop, are destitute of a head. Gr. a, without;. kephale, the head. AERATED, a term applied to water or other liquids when im- . pregnated with air. AERIAL RESPIRATION, breathing which belongs to the air, and is carried on by lungs, as distinguished from that which has reference to water, and is effected by gills. AFFINITIES, a term used to denote the close relationship in points of structure existing between different animals or groups of animals. Lat. affinis, allied to. AGGLU'TINATED, having the one part united to another as if glued together. Lat. ad, to, gluten, glue. French, agglutiner. AG'GREGATED, collected together. Lat. aggregare, to gather together. ALBU'MEN, a thick glairy substance like the white of an egg.

Lat. albus, white.

Some words, which strictly speaking are not scientific terms, have, by the advice of some experienced teachers, been introduced hi the Glossary. And for the same reason the Greek words, whence the terms are in many cases derived, are given, not in the Greek characters, but in the ordinary Italic letters, the Greek upsilon being throughout represented by the letter y.

ALIMINARY CANAL, that part of the intestine through which the food passes, yielding its nutritive portions to the action of certain vessels termed "absorbents." Lat. alimentum, nourishment.

AMBULA'CRA, a term applied to the rows of apertures in the Star-fishes and Sea Urchins, from a fancied resemblance to the straight alleys or avenues to old mansions. Lat. ambulacrum, an alley, a walk.

AMMONITES, a group of chambered shells, belonging to the Cuttle-fish tribe, and now extinct. They bear some resemblance to coiled snakes wanting the head, and take their name from a similarity in their form to that of the horns on the statues of Jupiter Ainmon.

AMPHI'BIA, an order of Reptiles, which, by the possession of both lungs and gills at the same time, or at different periods, are fitted to live either on land or in water. Gr. amphibios having a double manner of life.

ANALOGOUS, a term used in Zoology to denote a resemblance between two objects, or groups of objects, as distinguished from the real structural relationship denoted by affinity.

ANALOGUE, a term employed to denote the resemblance that exists between animals in a fossil state and species still living. The recent shell is said to be the analogue of the fossil.

ANALYSIS, the separation of a compound body into the several parts of which it consists. From a similar Greek word, signifying " unloosing."

ANATOMIST, one who cuts up or dissects portions of the animal frame, for the purpose of either acquiring, or communicating to others, a knowledge of their structure.

ANIMAL'GULES, those extremely small animals which are invisible to the naked eye. See INFUSORIA.

ANNELLA'TA, a class of articulated animals in which the body, like that of the Earth-worm, is composed of a number of links. Lat. annulus, a ring.

AN'NELIDS, the members of the above class. The name has the same origin.

ANNULOSE ANIMALS, those with the body formed of successive rings. Lat. annulus, a ring.

ANOMOU'RA, a section of crustaceous animals, distinguished, like the Hermit Crabs, by the irregular form of the tails. Gr. anomos, irregular, and oura, a tail.

ANTERIOR, Lat. that which goes before.

ANTEN'N E, the horns or feelers attached to the heads of insects and Crustacea.

A'PODA, without feet applied to fishes which, like Eels, have no ventral fins. Gr. a, without, pous, podos, a foot.

APPARATUS, the means or instruments for effecting a certain end. Lat. apparo, I prepare.

AP'TERA, an order of insects including all those which, like the Flea, are destitute of wings. Gr. a, without, pteron, a wing.

AQUATIC, belonging to or inhabiting the water. Lat. aqua, water.

ARACHI'NIDA, a class of articulated animals, including Spiders, Scorpions, and Mites. Gr. arachne, a spider, eidos, form.

ARBOREAL, belonging to or connected with trees. Lat. arbor, a tree.

ARBORESCENT, growing like a tree. Lat. arborescens, same meaning.

ARTICULA'TA, one of the great groups into which the animal kingdom is divided. It includes all those orders which are distinguished by their jointed or articulated structure, such as Worms, Crabs, Insects, and Spiders. Lat. articulus, a joint.

ASCIDIOI'DA, an order of Zoophytes, so named from their resemblance in some points of structure to the " ascidia" a genus of molluscous animals with a horny covering or tunic.

ASSIMILATED, converted into the same nature as another thing. Lat. assimilare, to become like.

ASTEROI'DA, an order of Zoophytes. The polypes, when expanded, exhibit a star-like figure. Gr. aster, a star, and eidos, form.

A'TROPHY, wasting from starvation.

AURICLES, two of the muscular cavities of the heart of man and other mammalia. Their form bears some resemblance to an ear; hence the name, from the Latin *auris*, an ear.

AVES, birds; they constitute one of the classes of the vertebrate animals.

BALEEN, the substance commonly known as "whalebone." Lat. *balcena*, a whale.

BARNACLE, a common name for one tribe of the articulated animals, termed *cirripeda*, which are found adhering to floating timber and the bottoms of ships. The common name is derived from the Saxon, *bearn* a child, and *aac*, an oak, "child of the oak," thus expressing the belief as to their origin.

"**BASIN** " of Paris, "Basin " of London. "Deposits lying in a hollow or trough, formed of older rocks, and sometimes used in geology almost synonymously with 'formations,' to express the deposits lying in a certain cavity or depression in older rocks." **LYELL**.

BATRACHIA, an order of reptiles, including the Toad and Frog. Gr. *batrachos*, a frog.

BILIARY DUCT, in anatomy, a canal or vessel through which the bile flows.

BI'MANA, the order of mammalia of which man is the sole representative. Lat. *bis*, twice, and *manus*, the hand, meaning two-handed.

BIVALVE SHELLS are those, like the Oyster and Cockle, which are formed of two parts. Lat. *bis*, twice, *valvce*, doors.

BRACHIO'PODA, "arm-footed," a class of bivalve molluscos animals, with long ciliated arms. Gr. *brachion*, an arm, and *pous*, a foot. **VOL. ir. M**

BRACHYU'RA, a group of crustaceous animals, distinguished like the Crab by the shortness of the tail. Gr. *brachys*, short, and *oura*, a tail.

BRAN'CHLE, the gills or respiratory organs of fishes and other aquatic animals.

BRANCHIAL, of or belonging to the gills.

BRANCHIAL SAC, a chamber in the tunicated mollusks; so termed because the blood is there exposed to the action of the air contained in the sea-water, which circulates over the interior surface of the cavity. Lat. *branchia*, a gill.

BRONCHIAL TUBES, the small branches of the wind-pipe. Gr. *brogchos* (pronounced *bronchos*), the wind-pipe.

BYSSUS, the silken fibres or "beard" seen in the Mussel and other bivalve shells. Gr. *byssos*, fine flax.

CADUCIBRAN'CHIATE, a term applied to that group of reptiles in which (like the Frog) the gills are not permanent. Lat. *caducus*, perishable, *branemce*, the gills.

CALCAREOUS, composed in a greater or less degree of lime.

CALLOW, unfledged; a term applied to the young birds while without feathers. Lat. *calvus*, bare or bald.

CALORIC, heat. Lat. *color*.

CANINE TEETH, the two sharp-edged teeth which are largely developed in the dog and other carnivorous animals. Lat. *canis*, a dog.

CARAPACE, the vaulted shield or shell that protects the upper surface of the body of the Tortoises, or *clielonian* reptiles. This term is also applied to the upper covering of the Crustacea.

CARBONATE OF LIME, the chemical union of carbonic acid and lime, as exhibited in limestone or chalk.

CARBONATED, combined with carbon.

CARMINE, a colouring substance of a brilliant red.

CARNIVORA CARNIVOROUS, terms applied to those animals which, like the Tiger, have teeth peculiarly adapted for the mastication of flesh. Lat. caro, carnis, flesh, voro, I devour.

CARTILAGINOUS, consisting of cartilage or gristle; applied to fishes that have the skeleton of cartilage, not of bone.

CAUDAL, belonging to the tail. Lat. cauda, a tail.

CELLULAR, composed of very minute cells. Lat. cellula, a little cell.

CEMENT, a substance employed in uniting bodies together. Lat. coementum.

CEPHALOPODA, an order of molluscous animals which have their organs of locomotion arranged round the head, as in the Cuttle-fish. Gr. kephale, a head, and pous, a foot.

CERVICAL, belonging to the neck. Lat. cervix, the neck.

CETACEA, one of the orders of the mammalia; it includes the Whales, Dolphins, and allied animals. Gr. Tectos, a whale.

CHEIROPTERA, the name of the order of mammalia comprising the various species of Bats. The term is suggested by the peculiar structure of the wings, which consist of a membrane extended over bones corresponding to those of the fingers. Gr. cheir, a hand, pteron, a wing.

CHEMICAL, anything relating to Chemistry that science which determines the constituents of bodies, and the laws which regulate their combinations.

CHRYMALIS, the second or pupa state of an insect. Some species exhibit at this time brilliant metallic tints; hence the origin of the term, from Gr. chrysos, gold. Chrysalids is used as an English noun in the plural number, to denote more than one chrysalis. **CILIA**, minute hair-like organs, which in the infusoria and polyps become important organs for locomotion, and for the capture of food by means of the currents caused by their vibration. Lat. cilia, eye-lashes. **CILIOERACTIA**, an order of polyps, in which the tentacula or arms, surrounding the mouth, are covered with cilia. Lat.

cilium, an eye-lash, brachia, the arms. **CILIOGRADE**, a group of rayed animals, like the Beroe, in which the cilia become the organs of locomotion. Lat. cilium, an eye-lash, gradior, I advance. **CIRRI**, the filaments attached to the jaws of certain fishes.

Lat. cirrus, a tendril or curl. **CIRRIPEDA**, an order of articulated animals, comprising the

Barnacles and Acorn-shells. Lat. cirrus, a curl, and pes, a foot. **COCOON**, the case or covering formed by an insect prior to its change into the perfect state. **COLEOPTERA**, an order of insects. It comprises the various tribes of Beetles, many of which have membranous wings concealed under the wing-covers or elytra. Hence the origin of the term, Coleos, a sheath, and pteron, a wing. **COMMUNUTED**, broken or ground down into small parts. Lat.

comminuere, to crumble into small pieces. COMPLICATED, involved or formed of many parts. CONCHOLOGY, the department of science which treats of shells.

Gr. kogche (pronounced conche), a shell, and logos, a discourse! CONCRETE, particles united or coagulated into one body.

Lat. condescere, to coalesce into one mass. CONCENTRIC, having one common centre. CONGEALED, hardened or frozen into ice. Lat. congelare, to freeze. CONGENER, one of the same genus, but of a different species. CONGLOMERATE, OR PUDDINGSTONE, a rock composed of water-worn fragments of rocks and shells cemented together. Lat. conglomerare, to heap together into a ball. CONTRACTILE, having the power of drawing itself into small dimensions. Lat. con, together, traho, I draw. CONVOLUTED, Lat. convolutus, rolled together. CORIACEOUS, resembling leather. Lat. coriaceus, leathern. CORNEA, the anterior transparent part of the globe of the eye. COROLLA, the blossom or coloured petals of a flower. Lat.

corolla, a little crown. CORUSCATION, a flash or sudden gleam of light. Lat. coruscare, to flash, to twinkle.

CRANIUM, the skull. Gr. kranion.

CREPUSCULARIA, a term applied to the Hawk-moths and other lepidopterous insects that fly in the twilight. Lat. crepus-culum, twilight. CRINOID, a family of Star-fishes which have a resemblance to the form of a lily. Gr. krinon, a lily, and eidos, form. CRUSTACEA, the class of articulated animals which includes the Crab, Lobster, and others possessed of a similar covering. Lat. crusta, a shell or hard covering.

CTENOID, a term applied to a group of fishes which have the edges of the scales shaped like the teeth of a comb, as in the Perch. Gr. kteis, ktenos, a comb, and eidos, form. CYCLOBRANCHIATA, an order of molluscous animals of the class Gasteropoda, distinguished by having the gills placed round the lower edge of the body, as in the limpet. Gr. kyklos, a circle, and branchice, gills.

CYCLOID, a term applied to a group of fishes which have the scales with circular or smooth edges, like those of the Herring. Gr. kyklos, a curve, and eidos, form. CYCLOTOMI, an order of cartilaginous fishes, which, like the Lampreys, have a circular mouth capable of acting as a sucker. Gr. kyldos, a circle, and stoma, a mouth. CYSTIC ENTOZoon, an internal parasite resembling a delicate cyst or bladder. Gr. kystis, a bladder.

DECAPITATION, the act of beheading. Lat. decapitare, to behead. DECAPODA, that division of the Crustacea which includes the Crab, Lobster, Crawfish, and others having ten feet. Gr. deka, ten, and pous, a foot.

DEGLUTITION, the act of swallowing. Lat. glutio, I swallow. DENTINE, the bony substance forming the principal component of the teeth. Lat. dens, a tooth. DIBRANCHIATA, a numerous family of Cuttle-fish (cephalopoda) comprising all species which are furnished with two gills. DIPTERA, an order of insects composed of two-winged Flies,

Gr. dis, two, pteron, a wing. DIURNA, a term applied to lepidopterous insects which fly by day, as Butterflies. Lat. diurnus, belonging to the day. DORSAL, belonging to the back. Lat. dor sum, the back. DORSIBRANCHIATA, a tribe of Annelids which have the gills placed on the back. Lat. dor sum, the back, branchice,

gills. ECHINODER'MATA, one of the orders of radiated animals: it includes the Star-fishes and Sea-Urchins. The term is expressive of the appearance of their integument. Gr. echinos, a hedge-hog; and derma, a skin or covering. EDENTA'TA, an order of mammalia, which comprises the Sloth and Ant-eater, animals which are either destitute of teeth, or have no incisors or cutting teeth. Lat. edentatus, without teeth. EFFETE, barren, worn out. Lat. eoetus, or effetus, decayed, past work.

ELY'TRA, the sheaths or wing-covers of coleopterous insects (Beetles). Gr. elytron, a sheath.

ENAMEL, in anatomy, the smooth and very hard substance which in various forms is seen on the crown of the teeth. ENCEPH'ALA, the group of molluscous animals which (like the

Snail) are furnished with a head. The name refers to this distinguishing characteristic. ENCRINITE, a name given to the "Stone-lilies," or fossil remains of the crinoid Star-fishes. Gr. krinon, a lily. ENTOMOLOGIST, one conversant with Entomology, or the branch of science treating of insects. Gr. entoma, insects, and logos, a discourse. ENTOMOS'TRACA, a term given to the minute freshwater crustacea and others having a flexible horny shell. Gr. entoma, insects, ostrakon, a shell. ENTO'ZOA, an order of radiated animals composed of what are called intestinal worms. Gr. entos, within, zoon, an animal. EPIDERMIS, the transparent membrane that forms the covering of the skin. Gr. epi, upon, derma, the skin. EPIZOA, external parasites; an order of Crustacea which particularly infest fishes. Gr. epi, upon, and zoon, an animal. ERRAN'TES, a tribe of Annelids; their name denotes their wandering habits. ERRATIC, wandering, irregular; not stationary nor fixed. Lat.

erro, I stray or wander. ESCULENT, eatable; that which may be used as food. Lat. esculenta, meat. EUPHONIOUS, having a sound that is pleasing to the ear. Gr.

eu, good or fine, and phone, sound. EXHUMATION, the disinterment of that which has been buried.

Lat. ex, out of, and humus, the ground. EXUDATION, the discharge of moisture from a living body, by the pores of the skin. Lat. ex, out, and sudo, I sweat. EXUVIAE, the cast skins or shells of animals. Lat. exuo, I cast off. FARINA, the pollen, or fine impregnating dust of the anthers of flowers.

FASCI'CULT, Lat. little bundles. FAUNA, the animals that are indigenous to a certain country or district. The term is derived from the Fauni, or rural deities in Roman mythology. FILAMENT, a thread or fibre; a long thread-like process. Lat.

filum, a thread. FISSION, that spontaneous division of the body which prevails in some of the infusory animalcules. FISSIPAROUS, reproduction by continual division of the body.

It is observed among some of the Infusoria. Lat. fissus, divided, pario, I produce.

FLORA, the plants belonging to a certain country or district. FOLIATED, having leaves. Lat. folium, a leaf. FOSSILS, the remains of animals and plants found in different geological formations. Lat. fossilis, anything that may be dug out of the earth.

FROND, a term applied to that part of flowerless plants resembling true leaves. Lat. frons, a leaf.

FRUGI'VOROUS, feeding on fruits, seeds, c. Lat. fruges, fruits or corn, and voro, I eat. FUR'CULOI, the bone of a fowl known as the " merry-thought."

Lat. furcula, a little fork. GANGLION, a knot or centre of nervous matter. An original

Greek word. GANOID, a term applied to a group of fishes, remarkable for the shining appearance of their scales. Gr. ganos, splendour, and eidos, form.

GASTERO'PODA, a class of mollusca, which (like the common Snail) have the lower surface of the body expanded into a muscular disc, that serves as an instrument for progression.

Hence the term " belly-footed." Gr. gaster, the belly, and pous, the foot.

GELATINOUS, resembling jelly. GEMMI'PAROUS, producing buds or gems. Lat. gemma, a bud, and pario, I produce.

GEMMULES, little gems or buds. Lat. gemma, a bud. GENUS plural, genera. Lat. A section consisting of one species, or a group of species of an indeterminate number, agreeing in some common characteristic. GEOMETRIC, in accordance with the rules or principles of geometry. GERMS, the apparent commencement or very early stage of existence in animal bodies. GLOBULE, a little globe. Lat. globulus. GLOTTIS, an organ situated at the upper portion of the larynx, and at the base of the tongue. Gr. glotta, the tongue. GRALLATO'RES, an order of birds known as "waders," and remarkable in general for the length of their legs, which gives them the appearance of being mounted on stilts. Lat.

grallæ, stilts. GRAMINIVOROUS, subsisting on grass. Lat. gramen, grass, and voro, I devour. GRAPHICAL, well delineated; described so as to convey to the mind a picture of a certain scene or incident. Gr. graplio, I paint. GREGARIOUS, having the habit of living together in a flock or herd. Lat. grex, gregis, a flock. GYRATION, a turning or whirling round. Lat. gyro, I turn round. HABITAT, the locality or situation in which an animal habitually lives. HELIANTHO'DA, an order of Zoophytes, in which the animals in their expanded state resemble compound flowers, like the sun-flower and marigold. Gr. helios, the sun, anthos, a flower, and eidos, form. HEMIP'TERA, an order of four-winged insects, comprising the

Field-Bugs, the Cicada, and others. The wings are partly membranous, and partly of a tougher material, a peculiarity which has suggested the name. Gr. htimi, half, and pteron, a wing.

HERBIVOROUS, living upon herbs. The Herbivora are those animals that feed on herbaceous plants. Lat. herba, an herb, and voro, I eat. HETEROGENEOUS, of a different kind or nature. Gr. heteros y different, and genos, a kind. HEXAGONAL, having six sides and six angles. Gr. hex, six, gonia, an angle.

HU'MERUS, the bone between the elbow and shoulder. HUMOURS OF THE EYE, the transparent portions consisting of what are termed the " watery, the " crystalline," and the "vitreous" humours.

HYBER'NATE, to retire into close quarters during the winter season. The Dormouse and the Marmot furnish familiar examples of hibernation. Lat. hybernus, belonging to winter.

HYDROI'DA, an order of Zoophytes; so called from their resemblance in some particulars to the fabled Hydra. **HY'DROGEN**, a gas forming one of the component parts of water and of atmospheric air. Gr. *hydor*, water, and *gennao*, I produce.

HYMENOP'TERA, an order of insects comprising Bees, Wasps, and Ants: they are furnished with four membranous wings. Gr. *hymen*, a membrane, and *pteron*, a wing. **HYPO'THESIS**, a supposition. **ICTHYO'LOGY**, the department of natural history treating of fishes. Gr. *ichthys*, a fish, and *logos*, a discourse. **JMA'GO**, a term applied to Butterflies and other insects, when their transformations are completed, and they assume the appearance of the species in its perfect state. **IMPETUS**, the force by which a body is impelled. **INCISORS**, the front or cutting teeth. Lat. *incisores*, a cutting. **INCUBATION**, the act of sitting as birds do on eggs, to develop the contained embryo. Lat. *incubo*, I sit. **INDIGENOUS**, produced naturally in a country; not exotic. **IN'DURATED**, having become hardened. Lat. *indurare*, to make hard. **INDUCTION**, an inference or general principle drawn from a number of particular facts.

INFEROBRAN'CHIATA, an order of molluscous animals, having the gills placed under the projecting margin of the mantle. The term simply means, having the gills below. **INFUSO'RIA**, the class of animalcules so called from their abounding in certain animal and vegetable infusions. **INSECTA**, insects. They form one class of articulated animals. **INSECTI'VORA**, an order of mammalia, the individuals of which, like the Mole or the Hedgehog, feed on insects and worms. Lat. *insecta*, insects, *voro*, I devour. **INSESSO'RES**, the order of perching birds. Lat. *sedere*, to sit, to rest upon. **INTEGUMENT**, that which naturally invests or covers another thing. Lat. *intego*, I cover. **INTERSTICES**, the spaces between objects. Lat. *interstitium*.

INVER'TEBRATE, without vertebrae. The term is applied to all those animals which in common language are destitute of a skull and backbone. **IRIDES'CENT**, having colours like the rainbow. Lat. *iris*, the rainbow.

ISOLATED, detached. Italian, *isola*. Lat. *insula*, an island. **LA'BIUM**, in entomology, the lower lip. The labial palpi in insects are the feelers attached to the lower lip. **LA'BRUM**, in entomology, the upper lip. **LAGOON**, a term applied to a small lake or pond of water; the word is derived from the Spanish *laguna*. Lat. *lacuna*. **LAMELLA**, Lat. a thin plate or scale. **LAMELLIBRANCHIA'TA**, a class of mollusca including the Oyster and other well-known Bivalves, in which the gills are in the form of membranous plates.

LARVA, the caterpillar state of an insect. Lat. *larva*, a mask. **LARYNX**, in the higher vertebrate animals, the organ of voice, situated at the upper portion of the windpipe. **LENS**, properly a small roundish glass, shaped like a lentile or bean. Lat. *lens*, a bean or lentile. The word is applied to both concave and convex glasses. **LEPIDOPTERA**, an order of insects to which the Moths and

Butterflies belong. The wings are covered with a mealy substance composed of minute scales. Gr. *lepis*, a scale, and *pteron*, a wing.

LIGAMENTS, the bonds or organs by which the various articulations of the body are held together. Lat. *ligamentum*, a band or tie. **LOBES**, the rounded divisions on the edge of a leaf, and applied to portions of the animal frame of a similar form. **LOCOMOTION**, the act of moving from place to place. Lat. *locus*, a place, and

motio, a moving. **LOPHOBRANCHII**, an order of fishes, in which the gills are arranged (as in the Pipe-fishes) in small tufts. Gr. lophos, a crest, and branchice, gills. **MACROURA**, a section of ten-footed Crustacea, distinguished (like the Lobster and Cray-fish) by the length of the tail. Gr.

makros, long; and our a, a tail. **MAGNESIAN LIMESTONE**, limestone which contains a portion of the earth magnesia. **MALACOPTERYGII**, one of the great sections into which the osseous fishes are divided. The rays of the fins are soft, and in general branched. Gr. malacos, soft, and pteryx, a wing. It is subdivided into three orders, Abdominales, Sub-brachiales, and Apodes. **MAMMALIA**, the class of vertebrate animals: it includes all those that suckle their young. Lat. mamma, a teat. **MAMMIFEROUS**, having breasts or teats for the nourishment of the young by means of milk. Lat. mammai, teats; and fero, I bear. **MANDIBULI**, or **MANDIBLES**, organs for chewing. Lat. mando, I chew. Applied to the upper jaws of insects

MARINE, belonging to the sea. Lat. mare, the sea.

MARSUPIATA, an order of mammalia containing the marsupial or pouched animals. Lat. marsupium, a pouch.

MAUSOLEUM, a sepulchral building. The name is derived from one of extraordinary magnificence erected 353 B. c. to the memory of Mausoleus, king of Caria.

MAXILLAE, the jaws, in entomology, the term is applied to the lower jaws of insects.

MEDULLARY, resembling marrow. Lat. medulla, marrow. The term is used in speaking of the substance that unites the various parts of the sertularian Zoophytes into one living mass. Vide "Sertularian."

MEGATHERIOID ANIMALS, a group consisting of extinct species of the order Edentata. The name is derived from one of colossal size, the Megatherium. Gr. megas, great, and therion, a beast.

MEMBRANOUS, consisting of membrane.

METAMORPHOSIS, transformation; change of shape. The word is taken from the Greek.

MICROSCOPIC, visible only by means of a microscope or magnifying glasses.

MIGRATION, change of residence; removal from one locality to another. The term is applied to those periodical changes of abode observable in many species of birds and other animals.

MILLIPEDES, insects possessed of numerous legs, and belonging to the order Myriapoda.

MILT, the soft roe or spawn of the male fish; it is used to fecundate the pea or roe of the female.

MOLARS, the grinding teeth. Lat. molaris, grinding.

MOLECULES, a term derived from the French, and expressing very minute particles of matter.

MOLLUSCA, one of the great groups into which the animal kingdom is divided. It contains the soft-bodied animals popularly known as "shell-fish." Lat. mollis, soft.

MONAD, an atom that admits of no further subdivision. Gr. monas, a unit.

MONOGRAPH, a written description of a single thing, or class of things. Gr. monos, one, and graplio, I write.

MOULTING, the periodical change that takes place in the plumage of birds.

Mucus, slime, or slimy matter.

MULTIVALVE, a term applied to shells which (like the Chiton) consist of more than two valves.

MYRIA'PODA, an order of insects consisting of those which (like the Centipede and Millipede) have numerous feet. Gr. myroi, ten thousand, innumerable, and pous, a foot.

NATATO'RES, the order of swimming birds. Lat. nato, I swim.

NEUROPTERA, an order of four-winged insects, in which what are termed the " nervures " of the wings are so disposed as to form a kind of network (as in the Dragon-fly). Gr. neuron, a nerve, and pteron, a wing.

NEUTERS, a name given to the working Bees, to distinguish them from the males and females of the hive. **NICTITATING MEMBRANE**, that which is called the third eyelid in birds. **NUDIBRANCHIATA**, an order of mollusks in which the gills are naked or exposed (as in Eolis, Fig. 164.) Lat. nudus, naked, branchiae, gills.

OCELLI, little eyes. Lat. ocellus, a little eye. **(ESOPHAGUS**, the gullet. **OLFAC-TORY**, smelling, or having the sense of smell. Lat.

olfacere, to smell. **OMNIVOROUS**, eating food of every kind. Lat. omnis, all, and voro, I devour. **OPHIDIA**, that order of reptiles under which all serpents are included. Gr. ophis, a snake. **ORGANIC**, consisting of parts made to co-operate with each other, as in those which constitute the bodies of plants or animals. **ORGANIC REMAINS**, the remains of animals or plants (organized bodies) found in a fossil state. **ORGANS**, the parts or instruments by which certain objects are effected. Lat. organum, a machine or instrument. **ORTHOCE'RATITES**, a name given to a group of large chambered fossil shells, which are straight and tapering. Gr. orthos, straight, and Iceras, a horn. **ORTHOP'TERA**, an order of four-winged insects, in which the wings are longitudinally folded when at rest, as in the Cricket and Grasshopper. Gr. orthos, straight, and pleron, a wing. **OSSEOUS FISHES**, those that have the skeleton of bone. Lat.

05, a bone. **OTOLITES**, the ear-bones of fishes. Gr. ous, otos, the ear.

SvisActl rece P tacles for the e g s or ova"

OVI'GEROUS VESICLES, the little bladders or cells in which the ova or germs of some Zoophytes are observed. Lat. ova, eggs, and gero, I bear or carry. **OVIPAROUS ANIMALS**, those whose young are produced from eggs. Lat. ovum, an egg, and pario, I bring forth. **OVIPOSITOR**, the instrument by which eggs are deposited. It is remarkable for its great length in some species of insects. **OVO-VIVIPAROUS ANIMALS** are those in which the egg is ruptured in the act of deposition, and the young are brought forth alive. **OXYGEN**, a gas which is one of the constituent parts of water, and of atmospheric air; it is essential to animal life. **PACHYDERMATA**, an order of quadrupeds, including the Elephant, and other animals distinguished by having thick skins.

Gr. pachys, thick; and derma, the skin or hide. **PALPI** in insects, the organs popularly termed "feelers." Lat.

palpwn, a gentle touch or pat.

PAPILLAE, small projections or protuberances which resemble in form the nipple or the teats of animals. Lat. papilla, a nipple. PARASITA, animals that are parasitic, or draw their support from the bodies of other animals to which they attach themselves. Lat. parasitus, a parasite or hanger-on. PECTINATED, shaped like a comb. Lat. pecten, a comb. PECTINIBRANCHIATA, an order of mollusks in which (as in the

J3wcinum and the Murex) the gills are shaped like the teeth of a comb. Lat. pecten, a comb, branchiae, gills. PECTORAL, belonging to the chest. Lat. pectus, pectoris, the chest. PEDI'MANA, "foot-handed" a term applied to some of the monkey tribes that have opposable thumbs on the feet, but not on the anterior extremities, or, as they are usually termed, " the hands." PEDUNCLE, in Botany, the stalk that supports the flower; in

Zoology, it is employed as is also the word Pedicle to denote a small stalk or stem; thus many of the Crustacea have eyes mounted on foot-stalks or peduncles. Lat. pes, a foot.

PEDUNCULATED, having a stem or foot-stalk. PERENNIBRANCHIATE, that group of amphibious reptiles in which the gills are permanent. Lat. perennis, permanent or lasting, and branchice, gills. PETALS, the leaves composing the corolla or blossom of a flower.

Gr. petalon, a leaf. PETRIFIED, converted into stone. Lat. petra, a stone, and fieri, to become.

PHARYNX, the upper portion of the windpipe. PHENOMENON, literally that which may be seen; generally used to imply some striking or remarkable appearance. Gr.

phaino mai, I appear. PHOSPHORESCENCE, the light caused by phosphorus; very conspicuous and brilliant in some of the soft-bodied marine animals. PHYLLOPHAGOUS, "leaf-eating" a term applied to the Sloths and other animals of the same order. Gr. pilyllon, a leaf, and phago, to eat. PHYSIOLOGIST, one conversant with the laws of animal economy, or that knowledge which is denoted by the word " Physiology."

Gr. physis, nature, and logos, a discourse. PIGMENTAL CELLS, those which contain the colouring materials or pigments which give to the skin its peculiar tints. PINNAE, wings or pinions. The term is applied to the wing-like expansions of certain Zoophytes. "Pinnated," in Botany, means leaves that grow in pairs or like wings, from the leaf-stalk, as in the Ash or the Rose; and in Zoology, it is used to denote a wing-like appearance. PISCES, fishes one of the classes of vertebrate animals. PLACENTA, a network of blood-vessels by which the young of most mammalia are nourished prior to birth.

PLACOID, a term applied to a group of fishes having scales of a broad flat form. Gr. plax, a broad flat surface, and eidos, form.

PLAGIO'STOMI, the order of cartilaginous fishes which includes the Sharks and Bays. Gr. plagios, slanting, and stoma, a mouth. PLASTRON, a term applied to the shell or plate that covers the lower surface of the body of the Tortoise. PLECTOGNATHI, an order of osseous fishes in which the jaws are united, as in the Globe-fish and Trunk-fish. Gr. plektos, plaited, and gnathos, the jaws. POLLEN, the farina or fine dust contained in the anthers of flowers.

POLYGA'STRICA, one of the great divisions of the Infusory animalcules, characterised by the possession of a number of sacs or stomachs for the reception of food. Gr. polys, many, gaster, the belly. **POLYGONAL**, having many angles and sides. Gr. polys, many, and gonia, an angle.

POLYPPES, rayed animals which were formerly supposed to partake of the nature of both plants and animals. The tenta-cula when expanded bear some resemblance to the arms of Cuttle-fishes, known to the ancients as Polypi; hence the origin of the name.

POLY'PIDOM, the horny sheath with which the soft body of the Polypes is invested. Lat. polypus, a polyp, and domus, a house.

PREHENSILE, having the power of seizing.") Lat.prehendere, to

PREHENSION, the act of seizing.) take, seize, or catch.

PRIMARIES, the terminal feathers of the wings of birds. They grow on the parts which correspond to the bones of our hands.

PRISMATIC COLOURS, the beautiful rainbow tints produced by the refraction of a ray of light by means of a prism. **PRIME'VAL**, belonging to the first or earliest ages. Lat. primum eevum, the first time. **PROBOSCIS**, a fleshy prolongation of the snout, as seen in the

Tapir, or in the trunk of the Elephant.

PROCESS, an anatomical term meaning a projecting portion. In this sense, it has a different signification from the same word as used in arts and manufactures.

PROPAGATION, the continuance of species; the generating of young individuals from the parent stock. Lat. propagare, to multiply or increase.

PRO'TOTYPE, the first or original form or model. Gr. protos first, typos, impression. In Zoology, the term is applied to a species in which the characteristics of the group to which it belongs are well developed.

PTERO'PODA, a class of mollusca which have two membranous expansions like fins or wings, and are hence spoken of as " wing-footed." Gr. pteron, a wing, and pous, a foot. **PULMONARY**, pertaining to the lungs. Lat. pulmo, a lung.

PULMONATA, the order of mollusks which breathe by lungs; the common Slugs and Snails are well known examples of the tribe.

PULMO'NIGRADES, the numerous tribes of Medusae or Jelly-fishes, which move by the contraction and expansion of the disc, and respire by the effects of the same movement. Lat.

pulmo, a lung, and gradior, I walk or advance.

PUP E, insects in that state which immediately precedes their appearance in their perfect or Imago form. **QUADRU'MANA**, the order of mammalia which includes the Apes and Monkeys. Quadrus, a derivation of the Latin word for four, and manus, a hand, as the four feet of these animals may in some degree be used as hands.

QUADRUPEDS, four-footed animals quadrus, from quatur, four, pes, pedis, a foot. The term is restricted to those that suckle their young; or, in other words, to the class mammalia.

QUARRY, the prey at which a hawk is flown. **RADIAL LINES**, those which extend from the centre of the Spider's web to the circumference, thus forming the radii of the circle.

RADIAL, the direction of the Rays of animals in which the radiated structure is most conspicuous, as in the Ray-fishes and Jelly-fishes.

RADIATED ANIMALS, or *Radiata*, one of the primary groups into which the animal kingdom is divided, in those the nervous system, so far as it has been observed, presents a radial or radiated arrangement.

RADIUM, *Radius*, extending or branching out in the manner of the branches of a tree. Lat. *ramus* branch, to make branches or boughs.

RAPTORIES, an order of birds which includes the Falcons, Owls, and other birds of prey. Lat. *rapto*, one who seizes, drags or takes away by force.

RASORIES, the order of "scratching birds." It includes the Hen, the Turkey, and other farm-door kind. Lat. *raso*, one who scrapes. **RHIZELL**, *Rhizell*, presenting the resemblance of network. Lat.

rhiza root. The wing of the Dragon fly is of this kind. **RETRACTILE**, capable of being drawn back. Lat. *retrahere* retract, to retract, draw or pull back.

RODENTIA, the order of mammals known as the "gnawing" animals, including the Mouse, the Rat, and the Squirrel. Lat. *rodere* to gnaw.

ROTIFERA, the name given to the mass of the eye of fishes. **OTTIFERA**, one of the two great divisions of the Infusoria or Infusorians. Their name is derived from certain species which present an appearance resembling that of wheels in rapid motion. Lat. *rotas* a wheel, and *rotas* I turn. **RODENTIA**, that order of mammals which includes the Ox, the Sheep, and other animals that chew the cud. Lat. *ruminare*.

SACCHARINE, sugary, having the properties of sugar. Lat. *saccharum*, sugar.

SALICIA, an order of Korales composing the various tribes of *Sarac*. Or. *saura*, a kind of.

SCALLOID, climbing. Lat. *scalare*, to climb.

SCYTHIANELLA, an order of molluscan animals which have the gills protected by a shield. Lat. *scutum*, a shield, breast-plate, gills.

SEMIPTERES, the feathers belonging to the wings of birds, and which grow on the bones corresponding to those of the forearm, or that part between the wrist and the elbow.

SEMIPTERES, an extensive series of the stratified rocks which compose the crust of the globe, with certain characters in common, which distinguish them from another series below them, called *primary*, and from a third series above them, called *tertiary*. LUTELL.

SEDENTARY, remaining at rest, inactivity. Lat. *sedentarius*, from *sedere*, to sit.

SEPTUARIAN PLANTHYTES, those which bear a resemblance to miniature plants or flowers. Lat. *septa*, a little nosegay, wreath, or chaplet of flowers.

SEXILE, stinging, used sometimes in contradistinction to *pedunculated*; thus the eyes of some Crustacea are sessile, while those of others are said to be *pedunculated*, or on stalks.

SILEX, the earth entering into the composition of flint.

SILICATEX, flint, principally composed of the earth *silex*.

SPIRACLES, Lat. *spiraculum*, a breathing hole.

STERNUM, the breast bone, or the flat bone occupying the front of the chest.

STRATA, STRATUM. " The term stratum, derived from the Latin verb *sterno*, to strew or lay out, means a bed or mass of matter spread out over a certain surface by the action of water, or in some cases by wind. The deposition of successive layers of sand and gravel in the bed of a river, or in a canal, affords a perfect illustration both of the form and origin of stratification." **LYELL.**

STREPSIP'TERA, an order of insects consisting of the family of the Stylops. The term is derived from the Greek *strepheo*, to twist, and *pteron*, a wing; the first pair of wings being absent, and represented by twisted rudiments.

STURIONES, the family of cartilaginous fishes comprising the Sturgeons.

SUB-CAUDAL, a term descriptive of the situation of the pouch of the Pipe-fishes, which is at the lower part of the body and near to the tail. It is of course applicable to any other object similarly situated.

SUCTORIAL, sucking. Lat. *suctus*. The word is applied to those tribes of insects that obtain their food by suction.

SUPERINCUMBENT, Lat. *super*, above, *incumbens*, lying or leaning upon: a geological term used in describing the position of stratified rocks.

TECTIBRANCHIIA'TA, an order of mollusks, in which the gills are concealed under the fold of a mantle, as in the *Aplysia* or Sea-hare. Lat. *tectus*, covered or protected, and *branchice*, gills.

TENTACULA, retractile organs surrounding the mouth, and used by many aquatic animals for seizing their prey.

TERRESTRIAL, connected with or relating to the earth. Lat. *terra*, the earth.

TERTIARIES, the feathers in the wings of birds which grow on the humerus, or bone corresponding to that between the elbow and the shoulder.

TERTIARY ROCKS, " a series of sedimentary rocks with characters which distinguish them from two other great series of strata the secondary and the primary which lie beneath them." **LYELL.**

TESSELATED, divided into squares. The term is applied to a pavement formed of square-shaped stones, often of different colours. Lat. *tessera*, a square tile.

TESTACEA, mollusks with a shelly covering, such as the Snail, the Whelk, the Oyster. Lat. *testa*, a shell.

TESTUDINA'TA, that order of Reptiles which includes the Tortoises. Lat. *testudo*, a tortoise.

THORAX, the chest. In the true insects, the organs of locomotion, whether wings or legs, are attached to the thorax.

THYSA'NOURA, an order of apterous or wingless insects, which have the tail fringed with numerous minute hairs. Gr. *thysanoi*, fringes, and *oura*, the tail.

TORPIDITY, that state of rest observable in the hibernating animals, in which they remain without exerting any of the powers of active life, and with diminished animal heat and respiration. In many cases the word implies benumbed with cold.

TRACHE'A, the wind-pipe.

TRANSFORMATION, the changes which animals undergo in their progress from the ovum or egg state, until they assume the appearance of the perfect animal.

TRANSITORY, continuing but a short time.

TRANSLUCENT, permitting the light to pass through. Lat. *translucere*.

TRANSVERSE, across, being in a cross direction. Lat. trans-versus, from transvertere, to turn across.

TRILO'BITES, a tribe of extinct crustaceous animals, so called from the body being composed of three lobes.

TRIPOLI, a powder used for polishing metals and stones, first imported from Tripoli. It is composed in a great degree of the flinty cases of Infusoria.

TRIPOD, with three feet, or resting on some support of an analogous kind. Gr. treis, three, and pous, a foot.

TRIRADIATE, arranged in the manner of three radii, or lines proceeding from the same centre.

TUBERCLES, small pimples, or similar excrescences, giving a rough or warty appearance to the surface.

TUBULIBRANCHIA'TA, an order of mollusks, to which the Vermetus belongs. The gills in some of the species are arranged in a somewhat tubular form, and follow all the windings of the convoluted shell.

TUNICA'TA, a class of molluscous animals, having a leathery or a membranous covering, instead of one formed of shelly matter. In many other respects their structure is very remarkable and peculiar. Lat. tunica, a tunic. **TYPICAL**, that which is regarded as the type or representative of a particular group. **UNDULATION**, a movement in curved or arching lines resembling that of a wave. Lat. undulatus, from unda, a wave. **UNIQUE**, singular, single, one only. French, unique. **UNIVALVE**, a term applied to a shell which, like that of the whelk or the limpet, consists of only one piece. **VACUUM**, a space unoccupied by matter most usually employed to denote a space from which the air has been exhausted. **VENTRAL**, belonging to the belly. Lat. venter, ventris, the belly. **VENTRICLE**, a term applied to one or to two of the cavities in the heart of the vertebrate animals. **VERMIFORM**, worm-shaped. Lat. vermis, a worm. **VERMIGRADE**, moving like a worm. Lat. vermis, a worm, and gradior, I advance.

VERTEBRAL COLUMN. " Vertebral, as consisting of segments of the skeleton which turn one upon the other, and as being the centre on which the whole body can bend and rotate; from the Latin, verto, vertere, to turn." OWEN.

VESICLE, a small enclosed space like a little bladder. Lat.

vesicula. **VIBRATILE**, possessing the power to vibrate. Lat. vibrare, to shake.

VITALISED, with the power of sustaining life. The term is applied to water containing atmospheric air, and which is thereby fitted for the respiration of aquatic animals. Lat. vita, life. **VIVIFIED**, endued with life. Lat. vivere, to live vivificare, to cause or give life. **VIVIPAROUS**, producing the young alive. The word is used in opposition to oviparous, already mentioned. **WEALDEN FORMATION**, a geological term applied to a freshwater deposit in the South of England. It belongs to the upper part of the secondary series of rocks, and attests the former existence in that region of a large river. **ZOOLOGY**, that department of science that treats of the structure, habits, and classification of animals. Gr. zoon, an animal, and logos, a discourse.

ZOOLOGIST, one who has acquired a knowledge of Zoology. **ZOOPHYTES**, a class of radiated animals, formerly supposed to partake of the nature of both animals and plants. Gr. zoon an animal, and phyton, a plant.

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